SCIENCE

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INTERNATIONAL COOPERATION IN RESEARCH[1]

THE intellectual activity of the world, scientific, literary or emotional, passes alternately through fertile and through barren periods. Each fertile period has its characteristic peculiarities and though any one generation may not be competent to form a just estimate of its powers and effects, it is able to compare the fruits of its own labors with the harvest of its predecessors. You will probably agree with me that our age is distinguished by having disclosed a vast array of facts which take us nearer to the infinitesimal structure of matter and which reach further into the infinite design of the universe, than the boldest flight of imagination could have foreseen half a century ago. But we do not flatter ourselves that the intellect of our time, judged by the power of individuals, is exceptionally great. No doubt, men of commanding genius are still with us, but they are not more numerous or more original than in former times. What then is the peculiarity that has produced such great results? In my opinion what has been accomplished is due in great part to the spread of higher education, which has evolved an army of competent investigators possessing enthusiasm for research which now, for the first time, is led into useful paths by the few great minds, whose powers thus receive a wider range and become more productive. It is in this that our great strength lies.

[1] Address delivered before the National Academy of Sciences on the occasion of the semi-centennial celebration of its foundation.

The functions of an organization devoted to research are to take full advantage of all available mental resources. Intellect can not be artificially created nor can originality be taught, but whatever intellect and originality exist, may be directed into fertile channels, so that those who have the gift of connecting facts shall not fail because the facts are not available.

The advance of science demands that experiment or observation and theoretical discussion should advance in parallel lines. Without organization, one of the teams on whose joint exertions the advance depends is likely to outrun the other. Thus Newton, when he had formulated his law of gravitation, which connects the orbit of the moon with the acceleration of falling bodies, did not publish his discovery for many years, because he could not verify his theory as closely as he desired. It was only after the French Academy had accurately measured an arc of meridian and had discovered a substantial error in previous measurements that Newton's law of gravitation could be said to be proved. In this case theory had gone ahead of observation; but examples of the opposite kind will not be wanting so long as we have observers concerned entirely with the accumulation of data, content to leave discussion to the dim future. It is one of the objects of organizing science to bring the two factors to bear on each other.

International cooperation in research is necessary because scientific inquiries can not be divided into compartments limited by political boundaries. The very language which we use to express our thoughts is tied down by conventions, some of which we have absorbed as students, but which in the case of new branches of learning have formally to be agreed upon. Our measurements—and all accurate science depends on measurements—have to be expressed in units, and how are these units to be fixed except by agreement? While this will be acknowledged by every one, it is not equally recognized how much our present refinements in scientific research depend on organized efforts. Whether these efforts should be concentrated in a single laboratory or confined within one political unit or carried out by the combined scientific community of the world, mainly depends on the nature of the problem.

It is not my purpose to trace in detail the history of international problems and international organizations; but, rather, to show the great variety of problems in which useful results have already been achieved by international cooperation, and to bring the lessons of the past years to bear on the future.

I divide international cooperation into three categories:

1. Agreement on standards and units of measurement.

2. The distribution of work bearing on the same problem, between different nations, for the purpose of economizing time and expenditure.

3. The investigation of problems which can not be solved unless observations made with identical or similar instruments are obtained from different parts of the world and the records published in a homogeneous form.

I think all are agreed as to the question of units and I need not detain you by giving you an account of the various international conferences which have been held and agreements which have been arrived at on these matters.

As regards problems of the second category, they are those which deal mainly with the cosmos, as a whole, because their solution depends so much on the collection of statistics which exceeds the powers of

individuals or even of single nations. A few examples may illustrate what has already been accomplished. First, and foremost, we have the great star catalogue, initiated at an international congress twenty-five years ago, when eighteen observatories combined to divide the work, each taking a number of zones in the heavens.

The importance of this work will be plain to every one, and we must regret that it is still so far from being completed.

As it is not my intention simply to point out the merits of international work, but also to point out its difficulties, a few words may be said which are not intended as criticism, but which may serve to point out the weakness which arises when there is no central authority which lives longer than the single individual can expect to live.

Pioneers will always be found to initiate a work, but in time they die or retire from office; others take their places, and if these become more interested in fresh problems, the work suffers unless it is effectively impressed on their attention by some permanent body. Where to find such a central body, whose main functions would be to endow an undertaking with sufficient inertia to carry it over periods in which the work may seem to be a drudgery, is a matter which deserves careful consideration.

The completion of the "Star Catalogue," which has given rise to these remarks, is only the beginning of an even greater piece of work. When we have determined the positions and magnitude of stars at any one time, we have only taken the first step towards solving the main problem, and must proceed to measure the proper motions, the parallaxes, and also map the spectra. This work is so vast that all hope to accomplish it within reasonable limits is difficult and has to be abandoned unless our statistical ambitions are lowered, and instead of taking the complete sphere of the heavens we select restricted but typical areas for detailed examination. This has been done on the initiative of Professor Kapteyn, who has secured a sufficient number of voluntary associates who are now carrying out a combined undertaking which has already yielded results of the greatest importance, and you will hear something more of this work from his own lips.

Now the essence of work of this kind consists in shortening the time required to accomplish an extensive task by dividing it among a number of persons. If the work is purely statistical it may be complete in itself, and the published records become then available to any one who requires them. In other cases, the observations may have to be collected by a central authority and treated by recognized methods of statistics or analysis before they become useful to the scientific public. While it is generally the observational portion of the work that is subdivided and the discussion that is centralized, the reverse is the case in the proposal made by Professor Pickering—that one central observatory in a favorable position should furnish photographs in sufficient numbers and distribute them among astronomers all over the world, to be measured and discussed.

Finally, a great undertaking of quite a different character—the "International Catalogue of Scientific Literature"—must be classed in the same category. This catalogue has arisen out of a desire to classify the scientific literature of the world, so as to enable any one who desires to study a certain subject to find out quickly all previous researches relating to it. Practically all nations in which scientific work is carried out have united, each

collecting its own data and forwarding it to the central bureau in London.

I can not pass away from this type of international cooperation without expressing regret that a proposal which was made by the late Professor Simon Newcomb has not been adopted hitherto. When the first program of the Carnegie Institution of Washington was being discussed, he proposed that there should be some central computing bureau established at one place where accumulated data of observation, which required scientific treatment, could be discussed and treated in that way. The number of instances which have come to my own notice within the last few years, in which the existence of such a bureau would have been of the greatest assistance to the progress of science is considerable; and I feel very little doubt that others have also felt the want.

The problems which fall into the third category are mainly those belonging to the important and much neglected subject of geophysics. The time is past when we could separate the physics of the laboratory from that of the earth, and that again from the physics of the universe. The experimenter who now studies the structure of the atom must keep an eye on the sun and stars in order to detect whether celestial observations destroy his theories or give them strength.

Atmospheric electricity and terrestrial magnetism, treated too long as isolated phenomena may give us hints on hitherto unknown properties of matter. A meteorologist, finding out at last that space has three dimensions, and that the motion of air is governed by the laws of mechanics, has converted what hitherto has been a sport into a science.

Before enumerating the international associations which are dealing with these problems of geophysics, let us say a few words as to the problems themselves.

We have, first, to study the shape of the earth and the variations in the gravitational forces which are observed on its surface. We have further to take account of the secular variations of level and of the more or less violent disturbances which accompany earthquakes and earth tremors. By comparing the indications of instruments placed in different localities, we can deduce the rate of propagation over the earth and through the earth of the seismic waves. This yields us important information on the physical properties or material composing the interior of the earth. The cause of terrestrial magnetism is at present unknown, and we have no means at our disposal to attack the problem directly, but the study of the diurnal and secular variations may give us a clue, and deserves our closest attention.

In a similar way, the study of the higher atmosphere and of the high electric conductivity which the air is now known to possess at heights which we can not reach, is also a subject which can only be studied by combined efforts. How are these questions dealt with at present?

We have, first, an International Association of Geodetics, which is an exceedingly efficient body, with a bureau at Potsdam, under Professor Helmert. That association is successful, perhaps, partly because its work has been facilitated in that it had to build on virgin soil. Nothing had been done, to a very great extent at any rate, internationally before that association came into being. On the other hand, we have the International Association of Seismology, a related subject, which was only founded at the beginning of the present century, with a central bureau at Strassburg. This association had to overcome more serious difficulties. It entered into the field when there was already a less expensive organization in existence, which had been originated by Professor Milne

and was directed by a committee of the British Association. The question of instruments also presented peculiar difficulties, which it is hoped may soon be overcome.

As regards terrestrial magnetism, I have only a few words to say.

Through the magnificent efforts of the Carnegie Institution of Washington, we are at last likely to have a satisfactory magnetic survey of the world, but important as the results obtained by Professor Bauer in the *Carnegie* will prove to be, they will have to be supplemented by systematic observations of the variations of the magnetic forces at a number of fixed stations. Many such stations are in existence, though they are very irregularly distributed over the surface of the earth.

In this subject, almost more than in any other, an international agreement on the manner in which the records are to be treated and published is essential, and it is much to be regretted that the attempts that have been made to reach such agreements have not met with greater success. There are, no doubt, peculiar difficulties due to differences in the organization of the magnetic services.

Methods have developed independently in different countries, and there is a natural but regrettable reluctance to alter an instrumental detail or a peculiarity in treating the observation until the necessity of the change has been demonstrated. But that can never be done, because practically all methods are equally good. What is bad is that they differ. Almost any one of these methods could be adopted with advantage anywhere; so that a discussion of which of the methods is better than the other is futile. The first essential then is that in every place on earth the same methods should be adopted, because the least difference in them may cause important errors in the deductions when they come to be compared with each other.

The only body which at present deals systematically with the records of terrestrial magnetism is a sub-committee of the Meeting of Directors of Meteorological Observations. The Directors of Meteorological Observations meeting at intervals have appointed a certain number of sub-committees dealing with a certain number of subjects. Some of these overlap other associations already. So that, for example, the question of solar radiation falls partly under that sub-committee of the directors of meteorological observations and also under the International Solar Union, a union which has been founded by your foreign secretary, Professor Hale.

The present international organizations differ considerably in the manner in which their expenditure is provided for. The International Geodetic Association, the Association of Seismology and the International Bureau of Standards are directly supported by the governments, the contributions depending upon the population of each country and amounting, for the larger ones to—I need not give you the figures now. They are of no particular interest.

The "International Catalogue of Scientific Literature" is a very costly undertaking, and that is provided for by each country guaranteeing the sale of a certain number of copies; a capital fund having been paid to start the organization by the Royal Society of London.

In the case of the great "Star Catalogue," each observatory is responsible for its own expenditure. The four French observatories have received government contributions amounting together to over $500,000. In England a much smaller sum has been given, and in other countries the

work has languished a good deal because sufficient funds were not available.

The Solar Union has no funds whatsoever and is even unable to pay for its own publications. Sufficient has been said to show how wide a range is already covered by international research. Further extensions of the work are constantly being called for, and we are brought face to face with the problem that separate associations can not be multiplied indefinitely without introducing difficulties which, as their number increases, endanger the objects which they are intended to serve. Apart from the overlapping of interests and questions of finance, the time spent in correspondence and administration is already serious. The nature of the problems suitable to be dealt with by international efforts is such that the same persons are generally interested in several of them, and the meetings succeed each other so rapidly as to become a serious tax on the time of those who attend them and some who used to look with favor on international work are beginning to be frightened.

Perhaps we may look forward to some arrangement to combine the meetings of the different associations in the manner of the different sections of the British Association, for instance. But this would require some central authority to act as a bond between the bodies which at present are separate and independent.

Economy of working, both financial and administrative, points in the same direction, and we are driven to the conclusion—and that, I think, I should like to make the moral of this paper—that the present policy of establishing a separate association for each new extension of international work should be reconsidered and an effort made to economize time in working and administration by some larger scheme, including the various separate international institutions on related and similar subjects.

Realizing that it is necessary to take some action in this direction, yet perhaps not understanding correctly why the action is necessary, an ambitious undertaking has been evolved in Belgium, where it is proposed to erect an office uniting international associations, whatever their object or character may be. The promoters have drawn up their statutes, one general congress has already been held, and another is now being organized. No success can, however, be expected from a scheme launched by a self-constituted and irresponsible body, unless its program commands general respect.

Is this the case in the present instance?

I do not know whether you realize the number of associations which exist. I shall not call them "international associations," but associations which call themselves international. The number to be united in this Belgium scheme is 279, and each of them, if I understand the proposals correctly, may have an office in a large building to be erected for the purpose. If you read through the list of these associations, I do not know what your feeling would be, but I can describe to you what mine has been; and it is exactly like that which I should have if I were to enter a museum, and find, side by side, the Venus of Milo, a living tiger, a collection of rare manuscripts and sanitary appliances. You will be interested to hear that, amongst the institutions which are to be provided for in this building, is the International Bureau of American Republics; but it is also intended to include "The International Congress for Providing Cheap Lodgings." Any one who enters the building and tries to find the particular room to which he wants to go has to ask the man in charge.

You can imagine this kind of a conversation taking place:

Is this the International Union of Friends of Young Girls?

No, but it is the International Congress of Commercial Travelers.

The architect, no doubt, will do his best to group together associations relating to the same subjects, and it would be interesting to pass through the corridors devoted to all the religious and irreligious societies that take the name of "international." If a humorist were to exchange the name plates over the doors, the mathematician who has traveled all the way from Australia to attend the "International Congress for Promoting the Study of Quaternions" might find himself in the room reserved for the "International Union of Woman Suffrage," and a member of the Association of Seismology might be mixed up with the "Association to Prevent the Abuse of Alcohol."

I do not like to throw ridicule on what is obviously a well-meant effort, but however much our sympathy may extend to each of these objects separately, no good purpose is served by inventing a connecting link between incommensurate objects, such as solar research and the proper observance of Sundays.

Our work is sufficiently difficult, if we confine ourselves to scientific methods. It nevertheless remains true that it is desirable to establish some central authority which can act as a connecting link between different associations. What should its functions be? It is the essence of all international combinations that they depend entirely on moral force and have no power to impose their decisions. A central authority must therefore be content with offering advice, with the conviction that, if the advice is sound, it will be accepted.

Though the existing associations would tolerate no interference with their independence, they would doubtless consider with care any suggestions made to them in the interests of science by an authoritative body. Our problem is therefore to find an authority of sufficient eminence to be generally looked upon with confidence and who could also act as adviser to different governments when they are asked to financially support some fresh undertaking. That is one of the most serious difficulties of the present time. There is a new international undertaking proposed almost every year, and application is made to the different governments for support and money. What is the government to do? To whom is the government to go for advice whether such an undertaking is worthy of support or not? My solution of that question is this: In the International Association of Academies we possess indeed a body fulfilling all the requirements of such a central authority, provided the individual academies constituting the association are willing to undertake the task. The Association of Academies was founded at a conference held at Wiesbaden on October 9 and 10, 1899, the National Academy of the United States being represented by Professors Newcomb and Bowditch. The paragraph of its statutes which were adopted at a meeting held in Paris in 1901 relating to the functions of the association runs as follows:

The object of the association is to prepare and promote scientific work of general interest which has been submitted to it by one of the associated academies, and to facilitate in a general manner scientific intercourse between different nations.

From its origin the association claimed an advisory voice in new international undertakings, and at the meeting held in London in 1904 the following resolution was passed with one dissenting voice:

That the initiation of any new international organization to be maintained by subventions from

different states demands careful previous examination into the value and objects of such organizations, and that it is desirable that proposals to establish such organization should be considered by the International Association of Academies before definite action is taken.

After a period of activity ranging over about twelve years it may be useful to review the work which has been accomplished, but I shall confine myself to the record of its section of science, remarking only that the section of letters has also much important work in hand.

The powers of the association are purely advisory; it has no funds at its disposal and for this reason alone is unable to initiate or support any scientific enterprise unless the individual academies provide the expenditure, as is being done, for instance, in the publication of Leibnitz's works, which has been undertaken by the academies of Berlin and Paris jointly. A complete map of the moon with its features named according to an agreed scheme is in process of preparation and is welcomed by students of the lunar surface. Among the subjects which have been treated, the excellent work done by an autonomous committee appointed to investigate the functions of the brain should also be referred to; and there are a number of various committees which have done good work.

In many cases the association has been called upon to express a favorable opinion on the importance of some international scheme which is independently being pressed upon the consideration of one or more governments. To deliver a platonic blessing is so gratifying a task that applications for it are not perhaps always scrutinized with sufficient care, though I admit that it is better to support a doubtful enterprise than to risk stopping a good one.

The association has been most successful when it has used its influence to press important scientific objects on the attention of their governments. It is in part at any rate due to their recommendation that money was found for the measurement of the great arc of meridian, which, covering 105 degrees, stretches through Russia and Roumania and continues through Asia Minor and western Africa, to the Cape of Good Hope. This is a continuous arc of meridian reaching from the north of Russia to the Cape of Good Hope in which a number of governments—the British government, the German government, the Russian government and the Turkish government—are involved, which is in process already, and is really nearing completion.

It has become the practise during recent years that international organizations established independently place themselves under the protection of the Association of Academies, to which they report periodically. Though the academies exercise no control over such bodies they stand to them as a reserve power willing to help when required.

In all these respects the association has fulfilled the intention of its founders, but has it left its mark to any appreciable extent on the progress of science? Without wishing to underrate the good that this body has done in the past I do not think I stand alone in hoping for a wider activity in the future, and I doubt whether it will long maintain its vitality unless it extends its ambitions as it passes from the age of youth to that of manhood. This is a critical period in its history, and much will depend on the policy it will adopt on a question which may still be kept in abeyance for a short time, but which will have to be faced before long.

An international organization which has no central office and is not domiciled in

any country is not a legally constituted body. It possesses no property. It can not accept gifts or legacies. The question has been repeatedly raised whether it is desirable to remove this restriction and to establish the association on a legal foundation. For this purpose it would have to place itself under the laws of some one country, and the selection of that country complicates the decision on the main issue, as national consideration and perhaps to some extent national jealousies have to be taken into account.

To clear our minds, let us separate the two issues, that of the power to hold property and that of a permanent domicile. Each academy knows from its own experience that though individual research may often be carried out at a small cost an organized investigation demands funds which become considerable when its range is wide. It is therefore just the type of work that an international organization is best fitted to undertake which demands the greatest amount of assistance.

The question to be faced is this:

Shall our International Association be forever content to exercise a purely platonic patronage, or shall it take an active part in promoting research? If it chooses the latter course it seems to me to be indispensable that it should have funds at its disposal.

I advocate the bolder policy on two grounds: Firstly, international research is most logically administered and paid for by international funds, and, secondly, it seems to me that a purely moral support can not, in the long run, remain effective. The existing special associations, as I have already stated, must retain their complete independence, and it is not likely that it will ever be desirable that the Association of Academies should undertake any work in which financial support is expected to extend over a considerable period; but when promising enterprises are in their experimental stages, funds are often most urgently required and most difficult to obtain.

It is here that an international body, having an independent income, could most efficiently step in to support meritorious enterprises during the few critical years until they can be either established on a permanent basis or have completed their work.

I recognize, of course, the weight of certain objections which have been raised, but I think we must run the risk all the same, for my experience teaches me that there is seldom any vitality without antagonism; and the main ground of objection is that we are going on so nicely, we never disagree and therefore we had better remain as we are. But after all, our progress is only obtained by those having differences of opinion coming together and adjusting their differences.

Even should the general opinion be against me, and if it were definitely decided that the International Association of Academies should forever maintain its present state of poverty, the establishment of a domicile on a moderate scale will have to be considered as an independent issue. It might be mentioned that in the original proposals of the Berlin Academy, they intended that there should be not only a central bureau but an organ, published monthly or quarterly, giving an account of the work done by any one academy that would interest the other academies.

The policy which the International Association of Academies will adopt on these questions is one of the most vital importance, for not only will the future of international work depend on the course

taken, but the reputation and influence of the academies themselves will, I am convinced, be seriously affected by the decision.

It is with the greatest hesitation and with much diffidence that I now approach the concluding portion of my discourse, for I am oppressed by the fear that my remarks may be taken as an unnecessary interference in the concern of others. But the issue is too serious to let that prevent my expressing an opinion which is based on a deep, and I believe impartial conviction.

The academies, royal societies, or whatever name they are called by, have been founded at different times in accordance with the varying requirements of their countries. They value their historical traditions above everything; some are over two hundred years old, others of recent growth, and their constitutions differ in many respects. But whatever their constitution and their history may be, they must be judged by this same test: Do they fulfill their obligations, which for all of them, I take it, are those defined in the charter of the Royal Society as "The promotion of natural knowledge." Do they embody in themselves the promotive power of the scientific efforts of their country, or have they fallen a prey to the dangers, which more especially beset the older institutions, of crystallizing into an aristocracy of science, recruited from those who in the natural course of growing maturity are ceasing to be active workers and constitute themselves to be the judges of the work of others? The dead weight of such a society brought to bear discretely on the exuberance of youth may have its uses, but it remains a dead weight just the same. It should act as a brake on a too fanciful imagination, but it can take no share in any real progress. If the academies are to fit themselves for the formation of a really strong and fruit-bearing association, they must be bodies which, animated, as all of them now are, by the highest and noblest ideals, strive at the same time to represent what is best and most progressive in the scientific life within their range of influence.

Each country must solve its own difficulties, but in addressing your national academy which, though it holds to-day its first jubilee, may still be called youthful, I may be forgiven if I remind you that, while the older institutions may offer you much that deserves to be admired and perhaps be imitated, you must not mistake the signs of gray hairs for the stamp of an enviable dignity.

This, then, is my final summary. Ours is an age of organization presenting many problems that can not be confined within political boundaries. The demands of science have already called into existence separate international associations, which are efficiently performing their duties. Nevertheless the continued increase of their number is beginning to cause inconvenience and is likely to hamper future developments unless they can be united by some bond intended to coordinate their work. The International Association of Academies stands out as a natural body, fit to act as a central advisory authority. To exercise that authority effectively, the academies must individually recognize their obligations to be truly representative of the most healthy and vigorous portion of the scientific life of their country. It is because I believe in the vitality of the academies and in the power which an increased responsibility will give them to check the danger of stagnation to which ancient and dignified bodies are exposed, that I advocate the extension of their activity and the

more vigorous exercise of the dormant power which resides in the union of the illustrious bodies which together constitute the International Association of Academies.

ARTHUR SCHUSTER
ROYAL SOCIETY OF LONDON

SIR WILLIAM OSLER'S SILLIMAN LECTURES

SIR WILLIAM OSLER delivered the first of his six lectures on the "Evolution of Modern Medicine" on the Silliman foundation at Yale University on Monday afternoon, April 21. The last lecture was delivered on the 28 ult.

In his first lecture, according to the report in the *Yale Alumni Weekly*, Dr. Osler dealt with the origin of medicine in primitive man and its relation to magic and religion. Certain special practises, such as trephining, were described and illustrated by the lecturer. Egyptian medicine was considered in its three important aspects—magic, the use of animal extracts, and the specialized modes of practise recorded in the famous Ebers, Hearst and Berlin papyri. Divination, particularly by inspection of the liver, astrology and the Hammurabi code, were taken as illustrating the special features of Assyrian and Babylonian medicine. The extension of astrology was traced through Greece and Rome. Among the Hebrews the excellent hygienic regulations were discussed and brief reference was made to the miraculous healing in the New Testament. Dr. Osler showed that the character of ancient medicine may be studied today in China, where charms, enchantments and death-banishing herbs are universally employed.

In the second lecture Professor Osler dealt with the beginnings of science in Greece, dealing first with the nature philosophers of Ionia and south Italy, whose contributions to medicine, while not numerous, were of great importance as influencing the thought of subsequent workers. The physicians of this school were independent of the Osculapian cult, the growth of which he then sketched as met with at Epidaurus and Cos. The work of Hippocrates was discussed and his fundamental proposition that disease was a natural phenomenon to be studied. The high ethical character of Greek medicine was illustrated by the famous oath of Hippocrates. The rise of the Alexandrian School and the study of human anatomy was then considered, and the high-water mark of the period was reached in Galen of Pergamus, whose life and work were described.

In the third of his lectures he treated medieval medicine. He traced the stream of Greek medicine through the three channels in the middle ages—the first continuous Greek tradition in south Italy, which found its highest development in the School of Salernum; secondly, through the Byzantine sources; thirdly, through the Arabs, who by the ninth century had had translated for them all of the Greek writers. From the Spanish translators of the thirteenth century, from Salernum, and by the dispersion of learned Greeks with their manuscript after the fall of Constantinople, Greek medicine reached modern Europe. He then traced the growth of the universities of Bologna and Montpelier and their influence upon medicine, particularly the former, where anatomy was first studied. Medicine of the middle ages was a restatement from century to century of the facts and theories of the Greeks, modified here and there by Arabian practise. In Bacon's phase there was much iteration, small addition.

In lecture four Professor Osler dealt with the beginnings of modern medicine as illustrated in the lives and works of three men. Paracelsus represented the spirit of revolt against authority and tradition. His positive contribution to medicine was small in comparison with the stimulus which his antagonism to the older writers aroused in his generation. Vesalius was the first to describe and illustrate with system and accuracy the structure of the human body. He may be said to be the creator of human anatomy as we know it. Professor Harvey Cushing, of Harvard,

showed a collection of first editions of the works of Vesalius, among which was the Fabrica of 1543, one of the most sumptuous works ever published. Harvey—the first great student of a function of the body—demonstrated the circulation of the blood in a series of masterly experiments which have been a model for all subsequent workers. In the publication of the "de Motu Codris," modern physiology may be said to have had its origin.

In lecture five Professor Osler described the steps by which we had obtained our knowledge of the changes wrought in the body by disease—morbid anatomy, the rise of clinical medicine, the introduction of means of physical diagnosis and the development of experimental pathology. The modern study of infectious diseases was traced, the work of Pasteur and of Koch described, and the practical application by Lister of the antiseptic method. The new problems in relation to the internal secretions were discussed, and it was held that the future would be largely concerned with studies in metabolism and clinical chemistry.

In the last lecture the practical application of the knowledge derived from recent researches was considered in relation to some of the more important diseases. The story of malaria was told in full and it was urged that a more active campaign against the disease should be undertaken in the southern states. The victory over yellow fever was retold, and the experience of the Panama Canal Commission was held up as a model showing what efficient organization will do. The building of the canal was made possible by the work of Laveran and of Ross and of Walter Reed and his colleagues. An appeal was made for more efficient control of typhoid fever and for a continuance of the fight against tuberculosis.

PROFESSOR BOWMAN'S EXPEDITION TO THE CENTRAL ANDES

Professor Isaiah Bowman, of Yale University, sailed from New York on April 26 to conduct a South American expedition under the auspices of the American Geographical Society. His purpose is to complete the investigations he began in 1907 in northern Chile and Bolivia and continued in 1911 in the basin of the Urubamba River, Peru. His work this summer will be in that part of the central Andes lying in Peru, northwestern Argentina, adjacent portions of northern Chile and southwestern Bolivia. Professor Bowman will be accompanied by Mr. H. S. Palmer as geologist and a surveyor.

His field work will chiefly relate to the anthropogeography and the physiography of this region. The investigation of topography, drainage and climate will thus go hand in hand with the distribution and customs of the people. Part of the work will lie in the driest portions of the Puna of Atacama and the adjacent desert of Atacama where villages in isolated situations, vast salt plains and lofty table lands alternate with rugged volcanic masses and snow-capped sierras. It is a little-known region and some of the most interesting parts of it have not yet been studied scientifically. The climatic conditions are of great interest and the possibility exists of securing critical data on past changes of climate since the region lies in the transition zone of the horse latitudes, between the trades and the westerlies. The shifting routes of trade have had remarkable effects on the towns and villages scattered along them, not only in stimulating them to an unnatural degree, but also in sudden decay.

An attempt will be made to cross the Andean Cordillera and the Desert of Atacama along two different parallels where the contrasts in altitude are most marked and thus to study the distribution of people under extreme conditions of physical environment.

The last part of the field season will be spent in investigating the border of the Titicaca Basin and descending the Desaguadero River as far as possible towards Lake Poopó. The elevation of the ancient strand lines of Lake Minchin, which once occupied a part of the Bolivian high plateau, will be determined. The relations of this now vanished lake and Lake Titicaca have never been investigated and the key to the problem will be sought in the outlet of the Titicaca Basin. There, also,

must be sought the key to much of the early history of the Titicaca depression. The Tiahuanaco Valley and its celebrated ruins will be studied in relation to the supposed ancient levels of Lake Titicaca and the limits of food production in the valley to-day.

Professor Bowman's results will be published in preliminary form in the *Bulletin* of the American Geographical Society and in final form in a volume entitled "The Central Andes."

GLACIAL EXCURSION OF THE CANADIAN GEOLOGICAL CONGRESS

SEVERAL of the excursions, in connection with the twelfth International Geological Congress, held in Canada next summer, will go from Toronto to Vancouver. Then an excursion (C8 August 29 to September 22), under the leadership of R. G. McConnell, and with guidance of R. W. Brock, D. D. Cairnes, and W. W. Leach, will traverse the fiords of British Columbia, ascend the Skeena River valley from Prince Rupert to Aldermere by rail, visiting the silver-lead mines and coal mines, and continuing to Skagway by steamer. There will be stops at the copper mines on Portland Canal and the Treadwell gold mine on the Gastineau fiord at Juneau. The excursions will then cross the Canadian Coast Range by the White Pass and Yukon Railway to Whitehorse, stopping at the copper deposits there and the coal mines at Tantalus, descending the Yukon River to Dawson and the Klondike gold field in the driftless interior plateau near latitude 64° north.

After the return to Skagway an excursion, under the direction of Lawrence Martin of the University of Wisconsin, will be made, on a special steamer, to the Malaspina Glacier, Yakutat Bay, and Muir Glacier, where Russell Wright, Reid, Gilbert and Tarr have done world-renowned work. This glacial excursion will last five days, with a possibility of two days more in case of cloudy weather.

The first day will afford an opportunity of seeing the Fairweather and St. Elias Ranges, 16,000 to 18,000 feet high, and covered by snowfields and glaciers. These ice tongues include the La Perouse, Malaspina and many smaller glaciers. The front of the great piedmont ice sheet of Malaspina Glacier will be followed, affording an opportunity of seeing the tidal ice front of the Guyot lobe west of Yahtse River, the moraine-veneered ice cliff of the Seward lobe at Sitkagi Bluffs, and the forest-covered terminus of the Marvine lobe near Point Manby.

On the second day something will be seen of the eastern border of Malaspina Glacier in Yakutat Bay and the forested terminal moraine of the Yakutat Foreland. Landings will be made in Disenchantment Bay in connection with various glacial phenomena such as the shrub-covered ablation moraine upon the ice of Variegated Glacier, the streams engaged in carrying and depositing outwash gravels, the calving of icebergs from Hubbard and Turner glaciers, the cirque vacated by a fallen glacier, and the beaches, rock benches, sea cliffs and islands which were uplifted from 7 to 47½ feet during the earthquakes of September, 1899.

The third day will be spent on and near the Nunatak Glacier in Russell Fiord. Here the hanging valleys, the till-veneered, overridden outwash gravels, and the tidal, land-ending and cascading glaciers will be visited and studied, as well as the phenomena of glacial erosion in the barren area from which the ice has recently retreated and of fault scarps made during the 1899 earthquake. Some of these scarps are vertical and are 4½ to 8 feet high.

The fourth day will afford an opportunity of seeing the morainic and glacio-fluviatile phenomena about the terminus of the Hidden Glacier, which advanced 2 miles between 1906 and 1909, as a result of the earthquake avalanching in 1899 which has subsequently caused 9 ice tongues of Yakutat Bay to move forward. After this landing something will be seen of a fiord with submerged hanging valleys, submarine moraines, buried forests, shorelines depressed in 1899, and the high strand lines of a former glacial lake.

Part of the fifth day will be devoted to

Glacier Bay, where there has been a recession of 8¾ miles at Muir Glacier from 1899 to 1911. A landing will be made in Muir Inlet to see the buried forests, the vertical ablation of over 1,200 feet of ice in 12 years, and many other phenomena. The rapid recession of Grand Pacific Glacier in Reid Inlet at the head of Glacier Bay now places part of this fiord in Canada. The glacier melted back 5,000–7,400 feet in two months during the summer of 1912, as was determined by N. J. Ogilvie of the Canadian Boundary Survey. At the International Boundary there is now dry land and open fiord where the ice was at least 1,750 feet thick as recently as 1894. Sixty miles of Glacier Bay have been opened to the ocean by glacier recession since 1794, making an arm of the sea as long as Hardanger Fiord in Norway.

The National Geographic Society of Washington has made a grant of money to Professor Martin to enable him to make detailed studies at Grand Pacific and Muir Glaciers while the excursion is in the Klondike. He will (*a*) measure the recession of several ice tongues in Glacier Bay, (*b*) look for advances of glaciers, (*c*) study the exhumed forests in relation to former glacial oscillations, and (*d*) make soundings in Canada's new harbor and other uncharted waters recently vacated by the glaciers, to see the effects of ice sculpture below sea-level.

SCIENTIFIC NOTES AND NEWS

A TABLET in honor of Dr. Samuel Pierpont Langley was unveiled in the Smithsonian Institution on May 6. Addresses were made by Dr. Alexander Graham Bell and Dr. John A. Brashear. At the same time Langley medals were awarded to M. Gustave Eiffel and Mr. Glenn H. Curtiss. Later in the afternoon the Aero Club of Washington arranged hydroaeroplane maneuvers on the grounds of the Army War College in honor of Dr. Langley.

THE Chemical Society, London, will hold a special meeting on May 22, when a lecture in memory of Jacobus Henricus van't Hoff will be delivered by Professor James Walker, F.R.S., of Edinburgh.

DR. JOHN M. CLARKE, New York state geologist and director of the state museum, has been invited by the president and council of the Royal Society of Canada to deliver the annual public address before the society at Ottawa on May 28.

DR. E. F. ROEBER has been elected president of the American Electrochemical Society.

DR. A. E. KENNELLY, of Harvard University, has been elected an honorary corresponding member of the British Association for the Advancement of Science.

PROFESSOR L. J. LANDOUZY, dean of the Paris faculty of medicine, and known by his researches on nervous diseases and tuberculosis, has been elected a member of the Paris Academy of Sciences, in succession to the late M. Teisserenc de Bort.

SECRETARY LANE has announced the selection of Professor Adolph C. Miller, who holds the chair of economics and commerce in the University of California, as first assistant secretary of the interior. Secretary Lane intends to assign to Mr. Miller general supervision of the Bureau of Education and of the national parks; the direction of eleemosynary institutions, such as Howard University and the Government Hospital for the Insane, and the handling of legislative matters in connection with the constructive policies of the department.

DR. KARL KOETSCHAU, director of the Kaiser Friedrich Museum in Berlin, has accepted the directorship of the newly established Central Museum in Dusseldorf.

DR. ALBERT M. REESE, professor of zoology in West Virginia University, sailed on May 5, from San Francisco, on the army transport *Sherman* for Manila, to study the fauna of the Philippines and other regions of the orient, and to make collections for the Smithsonian Institution, from which institution he holds a commission as "collaborator in zoology." He will return to the United States in September.

FORMER PRESIDENT GEORGE E. MACLEAN, of the State University of Iowa, has accepted temporarily the position of specialist in higher

education in the U. S. Bureau of Education. He sailed May 1 for Europe to continue studies of the British universities upon which he will prepare a bulletin somewhat along the lines of his bulletin on "Present Standards of Higher Education in the United States," just issued by the bureau.

THE adjudicators of the Adams Prize of the University of Cambridge report that the two essays submitted to them with the following titles are of distinction: "The Theory of Radiation," by Mr. S. B. McLaren, and "The Fundamental Spectra of Astrophysics," by Dr. J. W. Nicholson, between whom the prize is divided in equal shares.

PROFESSOR C. J. KEYSER, of Columbia University, delivered the annual lecture before the Minnesota chapter of the Society of the Sigma Xi on April 24. The subject of his lecture was "Concerning the Figure and the Dimensions of the Universe of Space."

PROFESSOR WILLIAM MARSHALL, of the department of mathematics, addressed the Purdue Chapter of Sigma Xi on "The Theory of Relativity and the New Mechanics," on April 23.

PROFESSOR BERNHARD KRÖNIG, professor of obstetrics at Freiburg, has accepted an invitation to lecture on Röntgen and radium therapy for the American surgical society, Chicago.

PROFESSOR WILLIAM MORRIS FONTAINE, for thirty-one years professor of natural history and geology in the University of Virginia, distinguished for his researches in paleobotany, died suddenly of heart failure about one o'clock on April 30. Professor Fontaine was in his seventy-eighth year. After eminent service for forty years as teacher and investigator, Professor Fontaine retired in September, 1910, on the Carnegie Foundation.

PROFESSOR A. C. ELLIOTT, professor of engineering at the University College of South Wales and Monmouthshire, has died at the age of fifty-two years.

DR. ERNST GEORG RAVENSTEIN, the distinguished geographer and cartographer, has died at the age of seventy-nine years.

THE U. S. Civil Service Commission announces an examination on June 2, 1913, for associate physicists, qualified in mechanical or civil engineering and in electrical engineering, to fill vacancies in these positions in the Bureau of Standards, at Washington, D. C., at salaries ranging from $2,000 to $2,700 a year, the salaries actually paid depending upon the qualifications of those selected.

THE British Board of Agriculture and Fisheries proposes to award in October next twelve research scholarships in agricultural science, of the annual value of £150 and tenable for three years. These scholarships have been established in order to train promising students under suitable supervision, with a view to their contributing to the development of agriculture, either by carrying out independent research or by acting in an advisory capacity to agriculturists. They will be granted only to students who show distinct promise of capacity for advanced study and research in some one of the sciences bearing on agriculture. Applicants must be graduates of a university or holders of a diploma of a university or college of university rank, and application should be made not later than June 9 next on a form to be obtained from the secretary, Board of Agriculture and Fisheries, Whitehall-place, London, S.W.

AN industrial fellowship in plant pathology for the study of diseases of the potato has been established at Rutgers College, New Brunswick, N. J. Candidates for this appointment should write to Professor Mel. T. Cook at the above address.

GOVERNOR SULZER of New York has signed a law creating a State Board of Geographic Names, which is to consist of five members, of which the commissioner of education and the state geologist are *ex officio* members, and three of whom shall be appointed by the governor. The state geologist is the secretary and executive officer of this board. According to the wording of the law, the board is to have power as follows:

First. To determine and establish the correct historical and etymological form of the place names of the state and to recommend the adoption of such forms for public use.

Second. To determine the form and propriety of new place names proposed for general use, and under the law no corporation, individual or community is permitted to introduce such new place names without the consent and approval of this board.

Third. To cooperate with the United States Board of Geographic Names and with the United States Postoffice Department in establishing a proper, correct and historically accurate form for all place names proposed as designations of new postoffices.

UNIVERSITY AND EDUCATIONAL NEWS

Both houses of the Minnesota legislature have passed an appropriation bill granting practically everything asked for by the University of Minnesota. The bill carries items as follows:

Maintenance	$966,000
Fuel	120,000
Special maintenance	462,000
Special agricultural maintenance	326,000
Buildings and equipment	639,950
Agricultural substations	276,500
Special, certificate-plan, bill	500,000
	$3,290,450

Buchtel College, a successful institution of forty years' standing, has been offered to the city of Akron, Ohio, for use as a municipal college or university, according to information received at the United States Bureau of Education. The corporation of the college finds that the institution has trebled its attendance in the past ten years without sufficiently increasing its endowment, and proposes to transfer the entire plant and endowment, valued at $400,000, to the city, practically without restrictions of any kind. If the offer is accepted, Akron will have an educational institution of college grade that will meet the community's needs in a distinctly modern way. It will be known as the College or University of the City of Akron, although in the event of the establishment of other schools or colleges the name Buchtel College is to be retained for the liberal arts department, just as McMicken College is a part of the University of Cincinnati. In making their proposal the trustees point out, among other things, that as a municipal institution, and with very slight addition to the money now spent for educational purposes by Akron, the college would offer to all qualified students of the city a college education with free tuition; that the college can be made of practical use in the work of city government; and that the college will furnish an excellent basis for a greater municipal university that shall make ample provision for technical and professional training for the youth of the city.

To study the methods by which the University of Wisconsin is serving the state in various ways, a party of fifty public officials and prominent citizens of Philadelphia and other cities of Pennsylvania have arranged an inspection trip to Madison, Wis., for four days, from May 21 to May 25. The Pennsylvanians are particularly interested in the relation of the university to the state, cities and rural communities through the medium of the extension division's municipal reference library, commercial reference library, traveling package libraries, correspondence study courses, health bureau, classwork among students in extension centers in all parts of the state, vocational guidance and continuation school work. The distinctive work being done by the College of Agriculture through its own extension service, which includes demonstrational work on how to grow crops, improve the dairying industry, increase farm profits through the introduction of efficiency in farm management, etc., has also aroused the interest of the delegation from Pennsylvania. The ultimate object of the visit is to develop similar activities in connection with the University of Pennsylvania and Pennsylvania State College. The party will include, among others, Mayor Rudolph Blankenburg, of Philadelphia; Owen Wister, the novelist; representatives from the University of Pennsylvania, Pennsylvania State College and Franklin Institute; public officials from various cities; John P. Connelly, chairman of the

finance committee of the city of Philadelphia, and Morris L. Cook, director of the public works of Philadelphia.

THE trustees of Dartmouth College have voted, after the year 1914, to suspend for the present instruction in the last two or clinical years of the Medical School and to concentrate the resources of the school upon the first two years in medicine. Students thus trained will be well qualified to enter the third year of the courses offered by the best city medical schools and may there complete their clinical preparation for the degree of doctor of medicine. The reason given by the trustees for this action is that because of its location the school has found difficulty in meeting satisfactorily the steadily advancing requirements set by the medical profession for a larger supply and variety of clinical material for purposes of instruction. By the action of the trustees also provision is made to extend the work in business organization and management and in commerce. Principles of business management, heretofore a second-year course, will be given the first year. Professor Person and Henry Woods Shelton, appointed assistant professor, will offer new advanced courses in the application of principles of management in manufacturing and merchandizing, including selling, advertising and other specialized branches.

PROFESSOR ERNEST C. MOORE, head of the department of education at Yale University, has received an offer to become professor of education at Harvard University.

DR. JOEL H. HILDEBRAND, of the University of Pennsylvania, has been appointed assistant professor of chemistry in the University of California.

DR. ERNST HEDINGER, professor of pathological anatomy at Basle, has accepted a call to Königsberg in succession to Professor F. Henke.

MR. A. R. HINKS, F.R.S., chief assistant at the Cambridge University Observatory, has been appointed Gresham professor of astronomy, London, in succession to the late Mr. S. A. Saunder.

AT a meeting of the electors to the Plumian professorship of astronomy in the University of Cambridge, held on April 19, Mr. A. S. Eddington, chief assistant at the Royal Observatory, Greenwich, was elected to the professorship, in succession to the late Sir George Darwin.

DISCUSSION AND CORRESPONDENCE

THE NEED FOR ENDOWED AGRICULTURAL RESEARCH[1]

TO THE EDITOR OF SCIENCE: There exists a widespread confusion of thought in regard to what is needed for the advancement of the science of agriculture in distinction from what is needed for the promotion of the practise of scientific farming. Actually these two things are entirely distinct, and what is of great aid, or even essential to one, is usually of relatively little value to the other, and indeed may indirectly become a hindrance to it. To advance the science of agriculture means to make new and fundamental discoveries in regard to the natural laws on which crop production and animal production depend. To promote such advance plainly demands the conducting of scientific research of the highest type in the field of agriculture and the pure sciences—physics, chemistry and biology—which are fundamental to it. On the other hand, to advance or promote the practise of scientific farming means (*a*) to put into the hands of the practical farmer the most complete and authentic information which exists

[1] This communication was called forth by the discussion which has been going on in the newspapers regarding the proposed plan of Mr. Vincent Astor to utilize his estate for the promotion of agricultural science. It was originally published in the New York *Times* for February 21, 1913. The editor of that paper, however, saw fit to omit considerable portions of the communication as submitted to him, including the discussion of what I believe to be the most essential point indicating the need for endowed, as supplementary to tax-supported, agricultural research. The result was what I can only regard as an unfair and inadequate presentation of my views on the subject. Since the matter is unquestionably one of real significance to the cause of American science, I venture to offer here a complete statement of my position.

in regard to the scientifically correct principles and methods of farming, and (*b*) to stimulate him by every possible appeal to reason, ambition and thrift to put these methods into practise on his own farm.

From this brief statement it will be apparent that, broadly viewed, the successful promotion of scientific farming must depend in the long run on the advance made in the science of agriculture. The farmer can not be taught new principles and methods until these have been discovered by the investigator. All federal and state legislation in this country looking towards the development of our agricultural resources has included in its purview these two complementary, but in practise somewhat conflicting needs. But there has been comparatively little effective effort (aside from the Adams Act, which has unquestionably been of great aid to the cause of agricultural research) sharply to distinguish between these needs and to provide definitely and precisely for each. Generally speaking, and with the exception noted, the provisions for tax-supported agricultural work in the United States have attempted to kill two birds with one stone. The result has varied in different localities, but on the whole it may fairly be said that the effect has usually been much more marked on one of the birds than on the other. Undoubtedly this country leads the world today in the effective promotion of scientific farming. This enviable position has been gained through our splendidly organized system of agricultural education, comprising the colleges of agriculture in every state with their intramural instruction, on the one hand, and their extension activities, which reach an astonishingly large proportion of the farming population, on the other hand. Furthermore, to supplement the extramural work of the colleges we have the work of the experiment stations and state departments of agriculture and the federal department of agriculture. These institutions reach the farmer in many ways, but chiefly by the dissemination of useful information in the form of bulletins, and other (even more ephemeral) forms of literature. On the whole, it would be difficult, and indeed no one has ever done so, to devise a better and more effective system for the promotion of scientific farming than that which we now enjoy the benefits of in this country.

But what of the advancement of the science of agriculture? There we meet a totally different condition of affairs. Comparisons are proverbially odious, but I very much doubt if many *disinterested* scientific men acquainted with the field could be found to affirm that in this particular we lead the world. Theoretically it is a primary function of the state experiment stations to conduct researches of a fundamental character which shall be calculated to discover basic natural laws. Actually, with a few rare and partial exceptions, experiment stations do nothing of the sort. On the contrary, what they do engage in is experimental work of a kind carefully calculated to make as strong an appeal as possible on the basis of its supposed "practicality" to the scientifically uneducated and uncritical farmers who make up its constituency. The experiment station investigator in many cases (though happily not in all, as I am able personally to affirm after five years' experience in Maine) is compelled by force of circumstance over which he has no control to supplicate the great goddess Truth with one ear closely applied to the ground in order that he may catch the first and faintest murmur of "what the public wants." If he has the temerity to venture upon a piece of research for which by the most extreme sophistry no evidence of immediate practicality can be adduced, he must do the work *sub rosa* and publish the results in such place that by no possible chance can the constituency ever learn of it.

What has been said can not justly be regarded as a criticism of American experiment stations or their responsible managers. It is simply a fair and candid statement of an existing condition of affairs, which limits the usefulness of experiment stations in certain directions. The reason for the existence of this condition *primarily* lies *not* in any lack of high scientific ideals on the part of the directorate or the workers, nor in any mismanagement, either intellectual or material, of their institutions, *but is found in the fact that they are tax-supported.* The people who

support an institution by the payment of taxes rightly feel that it is their institution. If it engages for a considerable period of time in activities of which they do not approve, or which they regard as useless and frivolous they will either withdraw their support, or if this is practically impossible, they will, by the pressure of public opinion, bring about changes in its management until they get it controlled by men whose policy meets with their approval. Every experiment station worker knows this obvious fact. He must govern his actions in accordance with it if he desires to do *any* useful work in this field. Because of this fact, which is from one point of view a great advantage, the experiment stations have come to take a very important part in the promotion of scientific farming. Their achievements in this direction, viewed as a whole, over the past twenty-five years, are noteworthy in a high degree. But doing this has left but little time, energy, resources or brains available for fundamental research in agricultural science.

The greatest need of organized agricultural development in this country at the present time is, I venture to think, an endowed institution for agricultural research, which shall do for the science of agriculture what the Rockefeller Institute is doing for the science of medicine. This need the state experiment stations never can entirely fill, for the reason that the farmers of the country collectively are not and can not be expected to be qualified to judge either (*a*) what are fundamental problems or fields in which research should be carried on, or (*b*) what lines of investigation are likely to advance knowledge, or (*c*) what are appropriate methods of investigation in general and in particular. Yet these are matters which the interested taxpaying public in actual fact does, and will continue to pass judgment upon in the case of tax-supported institutions. I have no criticism to offer on this attitude of mind. It is human, and understandable, and has led to some excellent results, and I have no quarrel with it whatsoever. I merely affirm that it is not one well calculated to promote the advance of science. He who will endow on a scale in some degree commensurate with the importance of agriculture in the social and economic system, an institute for agricultural research and place its management in the hands of a board of directors, of which a majority shall be scientific men of standing, will do the world a service of inestimable value.

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BLOCKS AND SEGMENTS

IN the issue of SCIENCE for January 31, 1913, Dr. Geo. I. Adams proposes the use of the word *segment* for a general term to be applied to a minor part of the earth having the dimensions of a solid. He finds that this term has already been used in Chamberlin and Salisbury's text-book of geology in discussing continental and oceanic segments and asks, "If it is applicable to major elements, why not to minor ones as well?" The note is not untimely, as it is evident that there are some divergent practices in the selection of terms to denote the categories in question. A quotation is given from a prominent geologist who uses the word *segment* in the way to designate a minor part of the earth's exterior marked off by some structure. It is not evident, however, if the writer of the quotation meant to use it in as wide a sense as proposed in Dr. Adams's note; for it appears that Dr. Adams would apply the name segment to all parts of the earth's exterior marked off by faults.

It seems that a term has long been in use, at least among American geologists, to denote a minor part of the earth's exterior marked off by faults. This term is *block*, a short, clear-cut, Anglo-Saxon word, very suitable for such use as is now proposed for segment. The use of the word segment by Chamberlin and Salisbury is, as it appears to me, for the purpose of denoting parts of the earth, more or less commensurate with the geosphere itself. The term seems very appropriate in that sense. Smaller parts of the earth's exterior, marked off by faults or sharp folds, especially when not discussed in connection

with cosmogenetic problems, ought to be designated by a different term. The need of such a term has long ago prompted its adoption, as will be evident from the following quotations from various text-books and geological papers, selected somewhat at random.

"Manual of Geology," Dana, 4th ed., p. 366:

> The ridges of the Great Basin . . . have been assumed to be each limited by faults . . . and to have become, in effect, monoclinal orographic *blocks*.[1]

"Elements of Geology," LeConte, 5th ed., p. 239:

> The strata are broken into prismatic *blocks*. . . . The slipping of these *blocks* has given rise to cliffs.

"An Introduction to Geology," Scott, 2d ed., p. 5:

> Rocks are divided into still larger masses or *blocks* by . . . fissures and planes of dislocation, or faults.

(Pp. 464 and 465): The plateau of basalt has been fractured into a series of *blocks* which are tilted. . . .

"Exploration of the Colorado River of the West, and Its Tributaries," Powell, p. 184:

> The faults . . . divide the district under consideration into long belts or *blocks*. . . . In examining the downthrow of these *blocks*, it is observed. . . .

"Geology of the Henry Mountains," G. K. Gilbert, p. 23:

> The strata of the upper part of the arch (of Mt. Ellsworth) are divided (by faults) into a number of prismoid *blocks*.

"The Geology of the Eastern Portion of the Uinta Mountains," by J. W. Powell, pp. 16, 17:

> When the *blocks* into which a district of country has been broken by faults are greatly tilted . . . the uplifted edges of such *blocks* often form long mountain ridges. . . . In this region many zones are found to be divided into small *blocks* by faults. . . . Fig. 4 is a bird's-eye view of the *blocks* mentioned. . . . Fig. 5 is a diagram of the same region showing the *blocks* into which it is severed. . . . Many other areas far more complex than these have been discovered where a zone has been broken into *blocks* and these *blocks* tipped and contorted. . . .

"The Ore Deposits of New Mexico," Lindgren, Graton and Gordon, Professional Paper 68, U. S. Geological Survey, p. 25:

> The principal disturbances . . . are marked by a series of . . . ranges of apparently tilted *blocks*.

Bulletin of the University of Texas, No. 93; "A Sketch of the Geology of the Chisos Country," p. 80:

> It (the Chisos country) covers a part of a sunken *block*, which measures about 39 miles from east to west and which has settled from four to six thousand feet below the level of the terranes on either side.

Science, N. S., Vol. XXXVII., No. 945, p. 226:

> Keyes speaks of the "so-called fault-*block* mountains" and refers to a statement by Spur that no one has ever seen the fault-lines *blocking* out the desert ranges.

It will be seen from these quotations that *block* is a term which has long been in use, and which is being used at the present time with a definite meaning, similar to that proposed. It seems to be needed. If retained and used in the same sense as heretofore, it will aid in giving greater precision to the geological nomenclature. We need the term *segment* for a slightly different use, as already stated.

J. A. Udden

University of Texas

[1] Italics here and below by the writer of this note.

Critical Criteria on Basin Range Structure

Charles R. Keyes in a recent number of Science[1] presents a note entitled as above in which he expresses in general terms his lack of belief in "Basin Range Structure," so called, and suggests deflative agencies rather than local tectonic displacement as the important factor in the formation of such ranges.

The writer has no desire at this time to defend the hypothesis of basin range structure, though he is thoroughly convinced of the

[1] N. S., Vol. 37, No. 945, p. 226.

soundness of this tenet: but only to right any misconception which may arise from the slightly ambiguous statement made by Mr. Keyes in which the writer's name is mentioned. To be explicit: Mr. Keyes says: "The present sharp meeting of mountain and plain is now explained by causes other than dislocation, through ordinary stream corrosion according to Paige."

The writer wishes to say that in the paper from which the idea above is drawn[2] the process under discussion was the formation of certain sloping planated rock surfaces which though likely to originate on the borders of enclosed desert basins do not in the process of their formation vitiate in any way the hypothesis of basin range structure. In fact, such surfaces may be used to prove (by their elevated positions) the very existence of such faults as are needed to establish the basin range structure. They are but an incident in a long series of changes of which basin range structure itself is but a minor part. After all there is nothing inherently antagonistic in processes of deflation, stream erosion or block faulting. All have operated and are operating to-day and any explanation of physiographic forms or account of physiographic history which would ignore any one of them is open to obvious criticism.

SIDNEY PAIGE

[2] "Rock-cut Surfaces in the Desert Ranges," *Journal of Geology*, Vol. 20, No. 5, 1912.

AN INVESTIGATION OF A "HAUNTED" HOUSE

CALLED by telephone a few days ago to examine a large and handsome house in the Back Bay district of Boston for the reason that it was acquiring an unfortunate and annoying reputation as being "haunted," the writer found a really serious state of affairs.

The trouble centered in the third and fourth stories, which were occupied by the children and servants—the slumbers of whom were disturbed by strange sensations. It was said to be a common occurrence for servants to awake in the night with a sensation of oppression, "as if some one were tapping upon me," or with a "creeping feeling going all over me with a feeling of being paralyzed." Sounds were also said to be heard, as if some one were walking about the house or overhead. These sensations often continued after the sleeper was thoroughly awake and even after the lights had been turned on. The children of the family, who also slept on the upper floors, were similarly affected. A little boy, for example, awoke one night and inquired of his nurse why she had been lying on him, and persisted for some time in his delusion. Another child rushed screaming into the nurse's room crying that a man was waking him up, and asking why she let the man frighten him so. The children appeared sluggish in the morning and pale, even cold water losing its power to enliven them.

These and other symptoms were well defined and often repeated, and had extended over the period of about two months during which the family had occupied the house as tenants. Upon inquiry it appeared that previous tenants had been troubled in the same way, matters having reached the point where the servants actually talked of seeing walking apparitions. The present occupant, although not entertaining any vitalistic theory of the phenomena, was fully alive to the reality and gravity of the situation, and anxious to find the underlying cause.

A comparatively simple and mechanistic solution of the problem soon appeared. It had been suspected that the trouble might have its origin in undetected leaks of illuminating gas, and the writer was called in to verify this theory. It developed, however, that the large amount of "furnace" gas escaping from a viciously defective hot-air furnace was quite sufficient to cause the trouble. In this furnace the separation between the fire box and the hot air ducts (upon which the hygienic integrity of the apparatus depends) was badly broken and as a result the inhabitants of the house were bathed in an atmosphere of diluted flue gases. To make matters worse, a small boiler for a steam-heating system had been placed within the fire box directly over the fire, the effect being to cool the top of the fire and so promote incomplete combustion.

In the light of these facts the sufferers' symptoms are readily explained. Flue gases contain, and especially when combustion is incomplete, considerable amounts of sulphurous oxide and carbon monoxide, both distinctly poisonous gases. Furnace gas was common in this house and often very strong—so that the eyes watered and an appreciable effect could be felt in the throat, symptoms at once suggestive of sulphur. The rapid tarnishing of all silver objects was a further indication of the presence of this substance. For the most serious symptoms, however, the responsibility must be thrown on carbon monoxide. The poisonous nature of this gas is too well known to require comment, and sensations of oppression and other mental disturbance are typical of the more acute poisonings, while anæmia, malnutrition, loss of psychic powers and diminished vigor are characteristic of the chronic condition. That the trouble was most aggravated on cold nights—when windows were closed and ventilation poorest, and at the top of the house, is consistent with the furnace explanation. It seems probable that the belief in walking spirits was nourished by real noises coming from an adjoining house. Any such noises would, of course, be likely to be exaggerated in the minds of persons wakened in the night while suffering from carbon monoxide poisoning.

The hygienic lessons are patent. Here is a clear case of thoroughly serious poisoning which might have had at any time a fatal result, and all due to a defective hot-air furnace. This apparatus, often praised for its ventilating effect and probably with justice when in sound condition and properly operated, may evidently become a distinct menace to health. And may not there be similar cases of a milder order, such as escape detection while still causing slight poisoning? Emphasis is also thrown on to the entire question of the possible dangers from flue gases. Brick sewers have been found to be sometimes permeable to illuminating gas; may not these poisonous flue gases sometimes escape into houses through porous or leaky chimneys? Slight leaks of illuminating gas have often been suggested as a cause of headaches and anæmias of obscure origin; perhaps we should look to leaky furnaces and flue gases for similar effects.

This case should also be of interest to experimental psychologists and investigators of psychic and spiritualistic manifestations, since the reputation which this house was gaining as being haunted apparently arose in large measure from genuine sensations of apparitions and the like, induced by the breathing during sleep of a tainted atmosphere.

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SCIENTIFIC BOOKS

Das Erdöl. Seine Physik, Chemie, Geologie, Technologie, Und sein Wirthschaftsbetrieb. In fünf Banden. Herausgegeben von C. Engler und H. v. Hoefer. Leipsig, verlag von S. Hirzel. 1912.

With the vanishing supply of natural gas, and the diminishing output of the world's stock of light petroleum, this work appears at an opportune moment. The first volume edited by Dr. Engler under the title "Die Chemie und Physik des Erdöls," and just issued, contains 855 pages with full index, and 18 large plates, the latter giving complete analyses and optical activity of petroleum from the principal fields.

The scope of this work and its comprehensive magnitude as indicated by its title and fully substantiated by the first volume, promises the most thorough and complete compilation on petroleum and its products that has ever appeared. It is fortunate that its preparation was undertaken by two such well-known workers in this field. The name of Dr. Engler especially is familiar to every one who is interested in petroleum.

Since the comprehensive report on petroleum by Peckham, to the United States Geological Survey,[1] the great accumulation of lit-

[1] Report on the Production, Technology and Uses of Petroleum and its Products, Government Printing Office, 1885.

erature on petroleum has been partly summarized by Redwood,[2] by Richardson[3] and by Clarke.[4] It was evidently the plan of the authors of "Das Erdöl" to include all that is known concerning petroleum, and one does not proceed far in the perusal of this volume to be convinced that their object will be well attained. It is safe to assert that this work will be found readily accessible for convenient consultation by the investigator, experimenter and refiner, for it will be an indispensable aid to every one interested in this subject.

This volume is devoted to the varieties of bitumen as a generic term for solids and liquids, and to natural gas, their composition, genetics, occurrence, chemical and physical properties, optical characters, heats of combustion, fractional distillation and lubrication. But much the larger space is devoted to the composition of petroleum and its products, with a complete review of the series of hydrocarbons that have been found in petroleum, and the structural relations of the various series on the basis of the most recent classification of the hydrocarbons.

There is a full discussion of all investigations of petroleum from the beginning, and large space is given to the work on American petroleum. The identity of the naphtenes first discovered by Markownikow in Russian petroleum with the same constituents in American petroleum, and with the more recently synthetically prepared cyclo-hydrocarbons, is fully set forth.

It is gratifying to observe that the proof of the absence in any appreciable qualities of ethylene hydrocarbons, especially from American petroleum, is comprehensively presented, for the erroneous statements on this subject in all works on petroleum have been grossly misleading. An interesting résumé is given of the facts and theories relating to the natural formation of petroleum from a chemical point of view. The behavior of petroleum and its products towards reagents, the action of atmospheric agencies, oxygen and ozone, as well as light, are critically considered.

The complete description of crude petroleum from all well-known fields, including its composition and properties, will be serviceable to the prospector and the refiner. Pyrogenic decomposition under various conditions, with what is known to the refiner as cracking, receives careful attention, as does also such subjects as absorption, capillarity, conditions and limits of explosion, and physiological effects. Considerable space is devoted to lubrication and the efficiency of lubricants. The theory of viscosity and the laws and practical operation of frictional testing machines are presented, with comprehensive tables and ordinate diagrams of the relative and absolute viscosity of the hydrocarbons, both paraffine and aromatic.

Reference is made to the lack of efficiency of dry lubricants and attention is called to the great advantage of a combination of an oil lubricant with graphite in such form that it reduces very materially the coefficient of friction by saturating the bearing with graphite, and at the same time forming a coherent film. It is explained that the difficulty of obtaining graphite in a sufficiently fine condition has been overcome by the colloidal graphite recently discovered by Dr. Edw. G. Acheson which is used in the form of oildag, a suspension of colloidal graphite in a suitable oil or in the form of aquadag, a suspension in water. Diagrams and results of frictional tests on the Carpenter machine are presented, from which the following interesting conclusions are translated.

These experiments confirm also the theory that a proper use of the combined oil-graphite lubricant is in high degree profitable. Besides the reduction of the coefficient of friction which is important from an economical point of view, a material saving in wear of bearing surfaces and of the lubricant required are other essential features in reducing the operating cost. Then, too, the factor of safety in operating is essentially larger and the danger of overloading much less than with lubricants containing no oildag. These

[2] "Petroleum and its Products."

[3] "The Modern Asphalt Pavement," J. Wiley & Sons.

[4] "Data of Geo-chemistry," U. S. Geological Survey, 1908.

factors should be of especial importance in the lubrication of motors, flying-machines, automobiles and similar machines.

The work is presented in regard to paper and printing with the characteristic skill and care of the German publisher, and with the patient thoughtfulness on the part of authors and publisher that we are led to expect in German publications.

CHARLES F. MABERY

Applied Biology. An elementary text-book and laboratory guide. By MAURICE A. BIGELOW, Ph.D., Professor of Biology in Teachers College, Columbia University, and ANNA N. BIGELOW, Teacher of High School Biology. 8vo. Pp. xii + 583. New York, The Macmillan Company. 1911. $1.40 net.

Teacher's Manual of Biology. A handbook to accompany the preceding. By MAURICE A. BIGELOW, Ph.D. 8vo. Pp. viii + 113. New York, The Macmillan Company. 1912.

Readers of SCIENCE have sometimes been entertained by bursts of eloquent disapproval of all courses in general biology. Certain noted botanists especially have been wont to speak of such courses as impossible, decadent, reprehensible; as maladies of a peculiar American epidemic, that has, happily, long since run its course. Their ills have been solemnly charged against presumptuous zoologists who have rushed in where modest botanists fear to tread. Fie on any one who would teach about plants and animals in the same course!

This protest has been loud—perhaps a bit too loud; for certain it is that courses in general biology were never so widespread as at the present time, nor were there ever so many new text-books offered for such courses, not only in America, but in Germany and France as well. Perhaps the reason lies in a permanent educational need, which such courses fulfill. There are those who have tried to test the matter by scientific methods who think so.

Among the many new books offered in this field is an important one by the Bigelows for secondary schools. Its title is "Applied Biology," but, fortunately, the applied part of it is mostly in the title. It would be an important book, if for no other reason, because it represents a great deal of honest effort on the part of competent teachers of extensive and varied experience, to put together into one consistent course what they deem best of all that they have tried. One does not need to be committed wholly to its plan in order to agree that it has been carefully laid out, and based on long experience and good judgment.

It is a conservative book. It begins with a chapter on definitions and another on the distinctive characteristics of living things (22 pages). Then follow chapters on the frog and the bean plant, these two types serving as an introduction to animal and plant biology respectively (122 pages). Then follow the more customary series of plant and animal types, the plants in descending, the animals in ascending series (300 pages), leading to a concluding part devoted to the consideration of the principles of biology as applied to human structure and life (118 pages). In all this there is much careful culling of both subject matter and methods: and a well-balanced indoor course for city schools is the result.

The biology taught is distinctly that of the laboratory—not of the outdoors. While there are here and there hints of the existence of outdoor biological phenomena, there is no plan provided for the study of them.

The technical terms used are few, but adequate. One notes almost with surprise how great is the gain resulting from the omission of most of the rubbish of terminology that encumbers the average high-school text. Of more doubtful value is the relegation of most of the laboratory work to demonstration by the teacher. Though this saves time and yields fewer failures of individual experiments, one may well doubt whether the pupil will learn, by handling pen and paper and recording results, what the handling of the things would teach him.

The illustrations are old—some of them so old that the original sources appear to have been lost. The authors seem to think that "well-known figures from standard biological works are to be preferred to new ones." At least, they are cheaper. One notes with regret the perpetuation of the grossly inaccurate fig-

ure of a mayfly nymph (from Parker & Haswell) on page 399; also the confusion of the lettering in figure 32 on page 79 (from Bessey), and the use of the word ovary with very different meaning in this figure and in one on page 244.

Biological pickles do not seem, as a rule, to excite much enthusiasm on the part of a beginner of high-school age and exception may be taken, therefore, to the suggestion on page 389 that for practise with insects "a mixed lot preserved in wood alcohol or formalin is best." But, as a rule, the suggestions as to laboratory methods are excellent and the book, as a whole, is a valuable contribution to the literature of biological laboratory methods.

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THE SO-CALLED AEROSTATIC HAIRS OF CERTAIN LEPIDOPTEROUS LARVÆ

IN his valuable report on the dispersion of the gipsy moth,[1] Mr. A. F. Burgess emphasizes the very great rôle which is played by the wind in distributing the first-stage caterpillars. In this connection he calls attention to, and figures the so-called aerostatic hairs arising from tubercles in first-stage larvæ of the gipsy moth, though he does not commit himself to the theory that they, with their globular swelling at the base, actually aid in making the caterpillars more buoyant.

These peculiar hairs, to be found on first-stage larvæ of the nun moth, as well as of the gipsy moth, were first described by Wachtl and Kornauth[2] under the name of aerostatic setæ, while they designated the balloon-shaped swellings as aerophores. They have been subsequently noted by several workers.

As indicated by the name, the aerophore was supposed to be filled with air, and Wachtl and Kornauth believed that the aerostatic bristles presented a collection of balloons which function as an aeronautic apparatus. If their interpretation be correct, it is obvious that in both the nun moth larvæ and in the gipsy moth larvæ these structures play a very important rôle in aiding the dispersal of the species by the wind.

Those who hold to the view that the swellings are in reality aerophores have not sought to explain how it is that the almost microscopic structures should serve as "balloons" if they are filled with air. A balloon rises because it is filled with gas lighter than air. To be sure, Fernald[3] suggests that they are distended with air "or gas," but it is difficult to conceive of a possible source of a special gas.

Apparently, Professor Cholodkovsky was the first to suggest the true nature of the so-called aerostatic hairs. First, in a Russian forestry journal and then in Tubeuf's *Zeitschrift*[4] he called attention to certain serious objections to Wachtl and Kornauth's hypothesis. The fact that the swellings, or vesicles, shrink in dead larvæ, militates against the view that they are filled with air. On the contrary, it favors the view that they contain a fluid which, after the death of the larvæ, naturally must dry up. In larvæ preserved in alcohol, air-filled organs would soon lose their air content, but these vesicles remain for months as full and rounded as in the living larvæ. If such a preparation is allowed to dry on the slide all of the "aerophores" quickly shrivel.

Cholodkovsky, therefore, suggested that the swellings were not filled with air, but with a fluid, and that very probably this was a poisonous one, since the larvæ, in this stage especially, need protection against insectivorous birds. This view was confirmed by the study of sections, which showed a large, unicellular gland underlying each of the "aerostatic bristles" and opening directly into the cavity.

[1] Bull. 119, Bu. Ent., U. S. Dept. Agric., February, 1913.

[2] Wachtl, F. A., und Kornauth, K., "Beiträge zur Kenntniss der Morphologie, Biologie und Pathologie der Nonne (*Psilura monacha*)," Mittheilungen aus dem forstlichen Versuchsvesen Osterreichs, XVI., pp. 1–38, 1893, 3 pls.

[3] Rept. on the Gypsy Moth, Mass. Board of Agr., 1896, pp. 300–301.

[4] Cholodkovsky, N., "Ueber die sogenannten Aërophore der Nonnenraupe," *Forstlich-naturwissenschaftliche Zeitschr.*, III., pp. 240–243, 1894.

Subsequently Ingenitzky,[5] a student of Professor Cholodkovsky's, made a much more detailed study of these glands and distinguished them clearly from the trichogens, the enlarged hypodermal cells which give rise to the hairs.

It seems, then, very clearly established that the so-called aerophores have no function of rendering the larvæ more buoyant, but are really *toxophores,* as Cholodkovsky proposed to call them. The rôle of rendering the larvæ more buoyant may much better be ascribed to the long, thin hairs which, as the Russian observer points out, have an unmistakable resemblance to the pappus of some plant seeds.

Wm. A. Riley

SPECIAL ARTICLES

IS THE BIENNIAL HABIT OF ŒNOTHERA RACES CONSTANT IN THEIR NATIVE LOCALITIES?

The recent article[1] on "*Œnothera* and Climate," by R. R. Gates, is of particular interest to me since, for the past few years I have had in culture several of the races of *Œnothera "biennis"* from the vicinity of Ithaca, N. Y. Two (possibly three) of these races which are predominantly biennial in character have in culture in their native locality produced annual individuals. In one case (No. 2, *Œnothera nutans*) the seed was planted during March, 1911, and in May the boxes were kept in the garden with one transplanting until June, when they were transplanted in the open garden. From the experiences of the season of 1912, these rosettes of 1911 started in the greenhouse in March were not so far advanced as they would have been had the seed been planted in the open garden in April. Three out of about 50 or 60 came into flower early in September. Rosettes of the intermediate stage were well formed in August but these three individuals did not form the dense rosettes so characteristic of the others in late autumn. Two of these September flowering individuals were potted and taken into the greenhouse, where they flowered all winter. In the spring they were removed to the garden and kept in their pots, where they continued to flower until some time in August, thus flowering continuously for eleven months. Another race (No. 1, *Œnothera pycnocarpa*) under the same conditions remained strictly biennial.

In a third race (No. 17) seed was planted directly in the garden in the early spring of 1912. Eight or ten out of about 200, without the formation of rosettes, came into flower in August, matured seed and died. They were strictly annual. The others are now in the rosette stage.

In another race (No. 16), possibly identical with No. 2, the seed was planted directly in the garden on the same day as No. 17. Out of about 300 individuals one did not form a rosette. It came into flower in August, formed seed and died late in September. This individual was annual, but it remains to be seen if it is a mutant from this race, which can not be determined before the rosettes of the other individuals now passing the winter have come into flower.

From my experience in the culture of *Œnotheras,* which is not extensive it is true, I have come to the conclusion that their behavior as to a strict biennial habit even in their native locality may be different under culture either in the garden or greenhouse from what it is in the open under feral conditions. Fully formed rosettes potted in the autumn and taken into the greenhouse, kept there during the winter and removed to the garden in the spring did not form stems nor come into flower any earlier than those which wintered in the garden.

Another feature of considerable interest which has appeared in connection with some of my cultures may be mentioned here, but an account of the more important results are reserved until after another season's experiences. The feature to which I refer is the possibility of certain races of *Œnothera* becoming perennial or of taking on a perennial habit under certain conditions. Several plants of *Œnothera nutans* which matured in

[5] Ingenitzky, I., "Zur Kenntniss der Drüsenhaare der Nonnenraupe (*Ocneria monacha*)," *Horæ Soc. Ent. Rossicæ,* XXX., pp. 129–134, pl. VIII., Figs. 9–11, 1896.

[1] Science, N. S., 37: 155, 156, 1912.

late August and early September, were observed during late September and early October, after prolonged rains, to be putting out new branches which came into flower. Some of the stems of those which were dead formed distinct and strong rosettes from the root stock as lateral branches. If these survive the winter the rosettes will probably form stems and the plants will come into flower a second season, that is, the third season from the rosette stage. It would then be a perennial with the habit of a perennial root stock and annual flowering shoot. Several of the individuals which were putting out new branches in late September and early October were potted in early November and removed to the greenhouse where they have continued to produce new shoots, often slender and crowded, sometimes suggesting "witches' brooms." These branches arise from the old brown stalk which to all external appearance one would consider dead but on cutting the stem chlorophyllaceous tissue is seen. The very dark sky during December and January has been unfavorable for growth or flowering, and perhaps accounts to some extent for the spindling growth and lack of flowers during this period. On some of these plants the new growth occasionally wilts down, indicating perhaps that the old stems are somewhat deficient in conduction. After reading Mr. Gates's article (Jan. 24, 1913) I stepped into the greenhouse to see my perennial *Œnotheras* and lo, there was one flower.

This plant (of *Œnothera nutans*) continued to flower in the greenhouse until the middle of April when it was transplanted into the garden. The cold weather following proved to be too great a change from the warm air of the greenhouse and the stems died to the ground, but a small rosette which had formed from the root stock remains alive to this day (May 2). Three of those individuals which formed rosettes during the autumn and were kept over in the garden or in a cold frame have been transplanted to the garden. They are doing well and will probably produce stems and flowers this summer. These individuals, therefore, of *Œnothera nutans* have taken on a perennial habit.

These two species, No. 2, *Œnothera nutans* Atkinson and Bartlett, and No. 1, *Œnothera pycnocarpa* Atkinson and Bartlett are described in the May number of *Rhodora*, 1913.

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THE LOWER CALIFORNIA PRONGHORN ANTELOPE

THE Pronghorn of Lower California has recently been separated by Mr. E. W. Nelson as a sub-specific race. (*Proc. Biol. Soc. of Wash.*, Vol. 25, page 107.) The characters given have to do mostly with color and color pattern, while the horns are mentioned as shorter, rougher, more upright and less diverging than in either of the other forms, *americana* and *mexicana*. No mention is made of skull characters.

A fine series of six adult males and several females were recently sent to me from Calmali, L. C., the type locality of the new form. One of these males is now in the collection of the Biological Survey at Washington; the others are in the Museum of Comparative Zoology.

I have not compared the skins of these specimens, but careful measurements of the six skulls do show a real divergence when compared with five large male specimens from the Laramie Plains, southeastern Wyoming, in the Museum of Comparative Zoology. They are on an average longer in the face, and considerably narrower. The most significant measurements are: length of nasals, length of anterior nares, and smallest width between orbits. The nasal length of the California animals runs from 101 to 110 mm., while the Wyoming specimens show from 84 to 97 mm. Likewise the width between orbits scarcely overlaps in the two series. An arbitrary index of nasal length plus length of anterior nares, divided by width between orbits, gives for the *peninsularis* series 1.73, and for the *americana* series 1.51.

The occipito-nasal length is very much more uniform in the series of *peninsularis* than in that of *americana*, and is somewhat greater.

One specimen from Calmali, original No. 65, shows such an abundant horn development that it ranks fifth largest as to length of horn in Rowland Ward's list (sixth edition). The horns, sixteen and one eighth inches long, show a remarkably divergent tendency, there being seventeen and one half inches between them at the fork. The base measurement is six and one quarter inches, and the general form is clean and symmetrical, not stumpy, knobbed and aberrant-looking like some of the others from the same locality. There seems to be, however, in all the California horns a tendency to a very sharp angular bend at the terminal portion, instead of a gentle or even curve. Therefore this new race of Prong-horn has a characteristic skull modification and can at times produce fine typical horns, in spite of its seemingly unfavorable environment.

The type locality of *A. americana* is an indefinite one and is referred to the Plains of the Missouri. The five *americana* skulls used for comparison were taken near Percy, Wyoming, and are Nos. 43, 46, 49, 50, 52 in the Museum of Comparative Zoology.

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THE AMERICAN PHILOSOPHICAL SOCIETY

The annual general meeting of the American Philosophical Society was held in the rooms of the society in Philadelphia, April 17 to 19, inclusive, and constituted a most notable series of sessions. There were a large number of papers presented, their general character being of a high order of merit and the scope of subjects included wide.

The meeting was opened on Thursday afternoon, President W. W. Keen, LL.D., in the chair, when the following papers were read:

The Biographies of Suetonius: John C. Rolfe, Ph.D.

The Etymology of the Word "Ill": Hermann Collitz, Ph.D.

While most etymologists agree in regarding the word "ill" as a loan word from Scandinavian, no plausible etymology has as yet been given of the old Norse word ("illr") from which it is derived. The traditional etymology of the latter word, identifying it with English "evil," is untenable, for phonetic reasons. Both the form and the meaning of this word, however, may be accounted for by regarding it as the Scandinavian equivalent of the English word "idle."

The Treaty Obligations of the United States relating to the Panama Canal: Charlemagne Tower, A.B., LL.D.

Former Ambassador Tower discussed the basis upon which the Hay-Pauncefote treaty was concluded with Great Britain, and pointed out the legal obligation of the United States arising therefrom. He went back to the earliest discoverers and navigators and brought up to the present time the history of the governments of Central America, to show our connection with the enterprise of constructing the canal.

He quoted the Clayton-Bulwer treaty, signed in Washington in 1850, by which the governments of the United States and Great Britain declared that neither would ever obtain or maintain any exclusive control over the ship canal, would fortify or colonize, or exercise any dominion over Nicaragua, Costa Rica, the "Mosquito Coast" or any part of Central America.

Also, that neither Great Britain nor the United States would take advantage of any intimacy or alliance that it might have with any government through whose territory the canal should pass, to acquire or hold any rights or advantages in regard to commerce or navigation which should not be offered on the same terms to the citizens or subjects of the other.

By the Hay-Pauncefote treaty of 1901, Mr. Tower said that, being desirous to facilitate the construction of a ship canal to connect the Atlantic and Pacific Oceans, by whatever route might be considered expedient, and to remove any objection which might arise out of the Clayton-Bulwer treaty to the construction of such canal under the direction of the United States, without impairing the general principle of neutralization, the two nations agreed that the Hay-Pauncefote treaty should supersede the former treaty.

It was agreed also that the canal should be built by the United States, which should enjoy the exclusive right to provide for the regulation and management of it. To make the understanding between the two nations plain, the following specific stipulation was entered into:

"The United States adopts as the basis of the neutralization of such ship canal, the rules substantially as embodied in the Convention of Constantinople, for the free navigation of the Suez Canal, and further, 'The Canal shall be free and

open to the vessels of commerce and of war of all nations observing these rules, on terms of entire equality, so that there shall be no discrimination against any such nation or its citizens or its subjects, in respect to the condition or charges for traffic or otherwise.' ''

In view of all this the speaker urged that the United States is in honor bound never to do or allow anything which can be interpreted as in any way inconsistent with the terms of our treaties.

A Counsel of Perfection. A Plan for a State University and for an Automatic Collection and Distribution of a State Tax for Higher Education: JOSEPH G. ROSENGARTEN, A.M., LL.D.

In view of the proposed convention to revise the constitution of Pennsylvania, it may not be inappropriate to urge the preparation, consideration and discussion of a provision in the constitution for a mill tax for higher education in Pennsylvania.

The founder of the Philosophical Society was also the founder of what is now the University of Pennsylvania.

From the suggestion of a building big enough for George Whitfield's great audiences, Franklin drew the inspiration in 1740 for the Academy of Philadelphia, which grew into the College of Philadelphia, the University of the State of Pennsylvania, and the University of Pennsylvania of our own day.

Franklin (to-day Franklin and Marshall) College, of Lancaster, Pa., was a tribute paid to him in the closing years of his long useful life by his admiring contemporaries.

The constitution of Pennsylvania, adopted in his lifetime, pledged the support of the state to the university.

To-day there are, as reported by the National Bureau of Education, 87 state universities, and other state-aided institutions of higher education. More than twenty-five of them receive the proceeds of the so-called mill tax rate, varying in amount and methods of collection and distribution. Notable among them is the University of Wisconsin, with a tax of three eighths of a mill, yielding $1,103,029, with a total income from the state of $1,552,398, and from the United States of $80,000, under the Morrill land grants, and returning to the state a large and varied service in public work and commissions of many useful kinds.

Under the same fostering care, other state universities have grown rapidly into importance—notably Michigan, Indiana, Colorado, Illinois, Iowa, Kansas, Nebraska, Texas, and state aid thus secured by the mill tax has been supplemented by many magnificent gifts from individuals.

The question of how best to make constitutional provision for higher education has been discussed, and its advantages affirmed by Andrew White, of Cornell; President Swain, of Swarthmore; President Beardshear, of Iowa; President Jesse, of Missouri; Professor Herbert B. Adams and Professor Maphis, of the University of Virginia; Professor Lefevre, of the University of Texas; President Ellis, of Ohio, and by the representative educational leaders from all parts of the country.

In Pennsylvania, with a state revenue of over thirty millions, a mill tax would produce an income large enough to support all the universities and colleges and institutions of higher education in a way to make them of infinite benefit and credit to the state.

With a provision in the constitution for such a mill tax for higher education should go power in the legislature to create a state board of education, including in it the governor and principal officers of the state *ex officio* and representatives of universities and colleges and technical schools and museums.

Let the state be divided into three sections, eastern, middle and western, each with its local educational council, consisting of representatives from all the institutions of higher education in the section, these in turn to send one or more representatives to the state board of education. That body could frame a plan on which the proceeds of the mill tax should be distributed, according to numbers, standards, efficiency and other conditions prescribed for a share of the income from the mill tax.

In due time the weak colleges would see the advantages of union with others, thus increasing efficiency.

The University of Pennsylvania would naturally be the head of higher education in and for the state, other universities and colleges being affiliated with it.

State College should be made the great agricultural school for the state, attracting to it all branches affiliated in that important work, veterinary schools, forestry, conservation of natural resources, etc.

The University of Pittsburgh would be the head of higher education in the western part of the state, and naturally would become the center of all work for educating men in mining, metallurgy, electricity and the other arts and sciences needed in developing the great resources of the state.

Technical schools, the Franklin Institute, the Drexel Institute and similar bodies, as well as such institutions as the Academy of Natural Sciences, the Academy of Fine Arts, the Carnegie Institute of Pittsburgh, should be affiliated.

All degrees in course should be granted by the board of education through the University of the State of Pennsylvania, and to it should be affiliated all examining boards, such as those that now admit to the practise of law, of medicine, of pharmacy and of other professions requiring a state license.

In this way the state would unify and advance the work of higher education.

From the state board of education should come appointments for all scientific and technical commissions, thus enlisting for the state and its needs the service of trained experts in law and legislation, in medicine and the prevention of disease, in mining and other branches of scientific and technical subjects of inquiry.

Such commissions would go far to make a substantial return to the state for the income from a mill tax.

The preparation of a code of laws for the distribution of such an income could follow a provision in the proposed new constitution for the automatic collection of such a state mill tax for higher education.

A similar constitutional provision might be made for a tax for the support of purely public charities, under such regulations as would secure to the state and its people the highest efficiency and the most economical management of hospitals, homes, asylums for the insane, the blind and defectives and dependents.

The state board of charities should be given large powers of inspection and require standards of excellence that would put all such institutions in the highest state of efficiency.

Uniform methods of accounting, supervision of purchases of supplies, constant interchange of officers in charge would secure reforms that of themselves would invite increased gifts from individuals.

With a state mill tax for higher education and for purely public charities, Pennsylvania would take its place with the great western states, in which, with this fostering care, universities have rapidly grown great, in useful work and good results as well as numbers.

Reprisals, Contraband and Piracy under Queen Elizabeth: Edward P. Cheyney, A.M., LL.D.

The English had the reputation in the sixteenth century of being the greatest pirates in Europe. Everywhere that English ambassadors went they were forced to hear complaints of the seizures at sea by their fellow countrymen. The Venetian governor of the Island of Zante reports to his home government, "I am firmly convinced that there is not a sailor of that nation that is not a pirate." The reasons for this bad reputation were fourfold. In the first place many letters of reprisal were given by the government. Admiralty courts in many countries were inefficient or not inclined to do justice, and English merchants, after failing to obtain justice for injuries suffered, appealed to their own government and were given letters of mark and reprisal authorizing them to reimburse themselves from the property of fellow countrymen of those who had injured them, even though the governments of the two countries were in close alliance. These letters of reprisal were objects of value and were sold, divided, bequeathed or seized for debt; whoever possessed one having a right to seize goods from foreigners up to the value expressed in it. Seizures made on the authority of such letters seemed legal enough to the possessors, but they were scarcely distinguishable from piracy in the eyes of those whose goods were seized. After 1585, when Spain seized the English ships that were then in her harbors, the English government gave these letters still more freely to any one who could bring forward any shadow of proof that he had lost goods in Spain. This practically amounted to privateering against that country.

Secondly, Spain was largely dependent for food and warlike supplies on France, Holland and the countries along the Baltic. When England and Spain went to war England declared all such supplies contraband and seized ships of those nations taking such goods to Spain. The law of contraband was not yet well developed and the merchants whose goods were seized naturally resented it and declared the actions of the English captains piracy.

Adventurers with letters of reprisal, privateers and captains in the Queen's service seizing contraband, all had commissions for what they did. But there were many genuine English pirates who had no commissions. Their names became famous, they were very bold, were often in collusion with fitting-out merchants on shore or with petty officials of the coast districts, and were comparatively seldom captured or punished. They attacked English and foreign vessels alike and threw overboard passengers and sailors and carried away ships and

goods. In 1573, when the Earl of Worcester was on his way to France to represent the Queen at the christening of the French King's daughter, some pirates swooped down on his ship and carried away all valuables, including the christening presents for the little princess.

The punishment of pirates was very difficult. The usual criminal courts would not act beyond the confines of their own countries and pirates' crimes were usually committed on the high seas. Therefore special courts had to be constructed for their trial. Nine hundred and sixty men were indicted in the special admiralty courts for piracy between 1568 and 1600. When convicted, pirates were usually executed on Wapping on the Thames, a mile or two below London. Twenty-eight were hung there in the year 1575 and fourteen in 1579. A narrative still remains of a pirate named Walton, being led from Southwark to Wapping to be hung, tearing strips from his breeches of crimson taffeta and handing them as keepsakes to his friends who followed him. The government also made strenuous efforts to put down piracy by the appointment of special commissions to hunt out pirates and their confederates and by sending fleets to sea to capture them.

There was, therefore, no lack of actual piracy, but probably not more on the part of the Englishmen than of men of other nationalities. The reason for the especial reputation of the English in this regard was that in addition to piracy of the usual kind they were held responsible for the seizures by letters of reprisal and by privateers and for carrying out the practise of capture of contraband goods, to which England was naturally led by the economic dependence of Spain and her own advantageous geographical location.

Some Commercial Transactions in Babylonia during the Period of Greek Supremacy: ALBERT T. CLAY, A.M., Ph.D.

The Historical Value of the Patriarchal Narratives: GEORGE A. BARTON, A.M., Ph.D.

The science of history has revolutionized our knowledge with reference to the early history of all peoples, showing that the traditions of nations usually begin with mythical stories, which give place gradually to legends, and later emerge into history that is attested by approximately contemporary documents. Inevitably in the progress of knowledge scientific methods have been applied to sacred history. To-day scholars are divided, so far as the patriarchal narratives are concerned, into three groups. (1) The sincere, open-minded, reverent scholars, who believe that the scientific methods must be applied to the beginnings of the history of Israel as to those of other nations. (2) The reactionaries, who resent the application of scientific methods to ancient history. (3) The mythological, or pseudo-scientific school, which has become enamored of the scientific method from afar, but has never undergone real historical training. This school would regard most of the Biblical characters as mythical.

The tenth chapter of Genesis personifies Egypt, Elam, Assyria and many other nations as men. We know that these nations were not descended from one man. Whenever, then, we find a patriarch and a nation or tribe bearing the same name, it is scientific to assume that the patriarch is a personification of the nation or tribe. Arabian tribal traditions afford similar analogies. The twelve sons of Jacob are, then, the personification of the twelve tribes, and their history is tribal history. This was shown to apply to all but Joseph. There never was a tribe Joseph, but two tribes, Ephraim and Manasseh. The marriages of Jacob represent tribal alliances. Neither Joseph, Jacob nor Abraham can be accounted for in that way, as there were no tribes bearing these names. Are these three patriarchs, accordingly, nothing but myths? Is Abraham a moon-god as the pseudo-scientific school holds? Jacob-el, Joseph-el and Abraham were shown from Babylonian inscriptions to have been personal names in Babylonia before 2000 B.C., Jacob-el being sometimes even there shortened to Jacob. Records of Egyptian conquests of Palestine show that there were cities in Palestine named for a Jacob-el, a Joseph-el and an Abram. Many sources point to migrations from Babylonia to Palestine. Probably such men, heading migrations of Amorites, settled in Palestine and cities were named after them, just as we have our Jonesvilles, Billings, etc., in this country. When later Hebrews settled in these cities they gradually took over the names of the men from whom the cities were named, and wove them into their traditions. Around these names traditions gathered from many quarters were crystallized. These traditions can often be shown to embody real history, though history of a different sort from that supposed by the unscientific student of the Bible. Historical study thus makes it more probable that real men stand behind the stories of Joseph, Jacob and Abraham and that they are mythological personages. Many documents were quoted to substantiate the positions taken. One of the most interesting is a contract in which Abraham took part. It reads:

"1 ox, broken to the yoke,
an ox of Ibni-Sin son of Sin-imgurâni,
from Ibni-Sin
through the agency of Kishti-Nabium,
son of Eteru,
Abarama (*i. e.*, Abraham) son of Awel-Ishtar
has hired for 1 month.
For 1 month
1 shekel of silver
he will pay.
Of it ½ shekel of silver
from the hand of Abarama
Kishti-Nabium has received."

The Succession of Human Types in the Glacial and Interglacial Epochs of the European Pleistocene: Henry Fairfield Osborn, D.Sc., LL.D.

The Flora of Bermuda (illustrated): Stewardson Brown. Introduced by Professor Henry Kraemer.

In the studies of the land flora of Bermuda which have been carried on since September, 1905, in cooperation with the New York Botanical Garden, the islands have been visited during parts at least of all the months of the year except January, July and October. More than 1,450 separate collections of plants have been made from all parts of the archipelago with the exception of a few of the smaller islands which are only rocks with but little vegetation. The native species of flowering plants and ferns exclusive of the endemic forms number 155, all of which are identical with those existing on the American mainland or the west Indian islands. The fourteen endemic species, four of which have been added through these studies, are all more or less nearly related to those of the southeastern United States, West Indies or tropical continental America and probably derived from such ancestors by modification during long periods of isolation. It would appear, therefore, that the greater portion of the native flora has come to Bermuda from the southwest through the agency of ocean currents, hurricane winds and migratory birds, of which a considerable number of species visit the islands regularly each year.

A New Type of Sewage Disposal Tank: William Pitt Mason, M.D., LL.D.

Determination of Uranium and Vanadium in Carnotite Ores of Colorado: Andrew A. Blair.

Friday, April 18—Morning Session

William W. Keen, M.D., LL.D., president, in the chair

The Uses and Needs of Selachology (The Study of Sharks and Rays): Burt G. Wilder, M.D.

Interpretations of Brain Weight (illustrated): Henry H. Donaldson, Ph.D., D.Sc.

The Correlation of Structural Development and Function in the Growth of the Vertebrate Nervous System (illustrated): George E. Coghill, Ph.D. Introduced by Dr. H. H. Donaldson.

Recent studies in comparative neurology have resolved the central nervous system of vertebrates into four longitudinal divisions which are severally functional units. Among lower vertebrates the relative development of these divisions, the somatic sensory, the visceral sensory, the somatic motor and the visceral motor, has been in a significant manner correlated with the behavior of the species. Such correlations by the comparative method formed the point of departure for this study on the correlation of the behavior of embryos with the developing structures in the growth of the nervous system.

Embryos of Amphibia are found to be somatic sensory and somatic motor organisms. They give no evidence of visceral nervous functions until after the locomotor mechanism has become established. This mechanism develops out of three types of nerve cells, sensory, associative and motor. The sensory system of the trunk is formed of the giant ganglion cells of the spinal cord, which connect with the skin by means of dendritic processes. This sensory system of the trunk becomes functional earlier than does the sensory system of the head, which is the definitive system of cranial nerves. The associative cells form a ventral commissure between the sensory cells of one side and the motor cells of the other. The motor cells hold a relatively ventral position in the spinal cord and lower portion of the brain. They form a continuous motor column and tract on either side and connect with the muscles by means of collaterals from their axones. The development of this system of reflex arcs with a single final common path on either side may be distinctly correlated with the development of the behavior of the embryo up till the time when locomotion becomes perfectly established.

Some of the more general results of this method of study are: (1) the demonstration of the nature of the primary reflex arc of the vertebrate nervous system, (2) the discovery of the adaptive nature of the early reflexes when considered from the phylogenetic point of view, (3) proof that the final common path of the most primitive reflexes is elaborated into the nervous mechanism of locomotion, (4) the explanation of the typical be-

havior of a vertebrate upon the basis of demonstrable reflex arcs, (5) a distinctive contribution towards a biological neurology.

The Correlation of Structure and Function in the Development of the Nervous System (illustrated): STEWART PATON, M.D. Introduced by Dr. A. C. Abbott.

The Relation between the Physical State of the Brain Cells and Brain Function (experimental and clinical): GEORGE W. CRILE, M.D., Ph.D.

Life of Cells Outside the Organism (illustrated): ROSS G. HARRISON, M.D., Ph.D. Introduced by Dr. A. C. Abbott.

Heredity and Selection: WILLIAM E. CASTLE, Ph.D.

The Nature of Sex and the Method of its Determination (illustrated): CLARENCE E. MCCLUNG, A.M., Ph.D. Introduced by Dr. George A. Piersol.

Fever: Its Nature and Significance: VICTOR C. VAUGHAN, M.D., LL.D.

It has been shown experimentally that fever is due to the digestion of proteins in the blood and in the tissues. Bacteria are living proteins. They get into the body and grow, converting the proteins of man's body into bacterial proteins. After a period of incubation the cells of the body pour out a ferment which digests and destroys the bacteria. In this process fever originates. In itself fever is beneficial. It is a manifestation of the attempt on the part of nature to destroy the invading organism. However, nature may overdo the matter, and fever per se becomes dangerous when it goes much above 105°. Any kind of fever, acute fatal, intermittent, remittent or continued, may be induced in animals by repeated injections of properly graduated doses of foreign protein.

The Control of Typhoid Fever by Vaccination: MAZYCK P. RAVENEL, M.D.

Vaccination against typhoid fever as practised to-day we owe to the researches of Dr. (now Sir) Almroth E. Wright.

It was tried for the first time on a large scale during the Boer war. Since that time it has undergone investigation by scientific boards in several countries. In the United States it was recommended by such a board in 1909. The results were so favorable that it was made compulsory for all officers and enlisted men under forty-five years of age in 1911.

The most striking results were obtained during the mobilization of troops in Texas in 1911. There were 12,801 troops in Texas, all vaccinated. There was only one case of typhoid fever, occurring in a private of the hospital corps, who had not completed his immunization. The case was mild, and resulted in recovery. In 1898, 10,759 troops were stationed in Jacksonville, Florida, under very much the same conditions as regards climate, etc. Vaccination was not practised at that time. There were 2,693 cases known or believed to be typhoid fever, with 248 deaths. Wherever practised, very much the same story is told. The French troops in Morocco under most unhygienic surroundings have entirely escaped typhoid fever where vaccination was practised.

The method is an extension of the well-known bacterial vaccination discovered by Pasteur. It is now generally recommended for nurses in hospitals and those exposed to the disease.

In Wisconsin the State Laboratory of Hygiene sends out the vaccine free of charge to all physicians in the state. In more than three thousand vaccinations only two cases of typhoid fever have come to our notice; both of these cases mild and atypical.

The method has shown itself of great value in checking epidemics, and in the cure of typhoid carriers.

FRIDAY, APRIL 18—AFTERNOON SESSION

William B. Scott, Ph.D., LL.D., vice-president, in the chair

Guatemala and the Highest Native American Civilization: ELLSWORTH HUNTINGTON, M.A., Ph.D. Introduced by Mr. Henry G. Bryant.

Among the native civilizations of the western hemisphere that of the Mayas was decidedly the highest. Not only did they develop the arts of architecture and sculpture to a surprisingly high point, considering the fact that they had no tools of iron, but they were the only American race to evolve the art of genuine hieroglyphic writing. To-day the magnificent ruins of the later, decadent Maya period, dating about A.D. 1000, are relatively accessible, as they lie in the comparatively dry, open and well-populated strip which borders the peninsula of Yucatan on the north. The oldest ruins, however, those representing the period of highest development a few centuries after the time of Christ, are located in one of the most inaccessible, least explored, most unhealthful and most sparsely populated regions of America. The Guatemalan province of Peten, together with the immediately surrounding regions, where the greatest ruins are located, consists of a plain or low hills lying between the Atlantic Ocean on the east,

the Gulf of Mexico on the north and the high volcanic plateau of Guatemala on the west and south. It is to-day one of the worst possible environments for man. In the first place, it receives so much rain that it is covered for the most part with a dense tropical forest or jungle where the excessive moisture and rank growth of vegetation render it practically impossible to make clearings and practise anything but the most haphazard agriculture. In the second place the region suffers to a maximum degree from the disadvantages of a uniformly warm, moist, debilitating climate. And finally it is afflicted with the worst kind of tropical fevers which weaken and destroy white men and natives alike and render thousands of square miles practically uninhabited.

To-day Peten stands at the lowest point in the scale of American civilization. Close beside it the Guatemalan plateau with its drier, less debilitating climate, less dense vegetation, and relative absence of malarial fevers, is far in advance of it, although inhabited by practically the same race and governed by the same laws. Formerly the reverse was true; the plateau was, relatively speaking, only moderately advanced; that is, it was a provincial region, while the lowland was for many centuries the seat of a culture equal to that of the highest races of the eastern hemisphere before the days of Greece. In the last 1,500 years, more or less, there has evidently taken place a change of great magnitude. In explanation of this change three possibilities present themselves. First, the Mayas may have possessed a degree of energy and initiative and of resistance to fevers and to the debilitating influence of the torrid zone much in excess of that of any other known people. Second, in their day tropical fevers of the more destructive types may have been unknown in Central America; and, third, the climate may have changed. All three theories are probably true in part, but there is no independent evidence as to the first two. On the other hand, alluvial terraces and their relation to such ruins as Copan furnish strong independent evidence of climatic pulsations during the past 2,000 years. We are therefore led to conclude that although the Mayas were a remarkable people they did not of necessity excel all other races in their resistance to disease and in their power of overcoming the obstacles of a habitat—lowland forests in the moister portions of the torrid zone. In their day, apparently, the earth's climatic zones were shifted somewhat equatorward, so that in winter the conditions of the dry subtropical zone of high pressure and perhaps the rainless fringes of our cyclonic storms prevailed in the country. The yearly dry season thus produced, probably prevented the growth of dense forests, made agriculture possible, greatly reduced the amount of disease and acted as a direct stimulant by relieving the deadening monotony of the almost unchanging moist heat. A relatively slight climatic change such as this would alter the physical environment of Peten from exceedingly unfavorable to relatively favorable, and would render the location of the highest native American civilization rational instead of almost inexplicable.

Further Considerations on the Origin of the Himalaya Mountains and the Plateau of Tibet: T. J. J. See, A.M., Ph.D.

Dana's Contribution to Darwin's Theory of Coral Reefs: William Morris Davis, Sc.D., Ph.D.

It is fitting on the hundredth anniversary of Dana's birth to call attention to a significant contribution that he made many years ago to Darwin's theory of coral reefs, all the more because, although it has high confirmatory value, it has been strangely overlooked by most students of the coral island problem. Darwin, as is well known, explained barrier reefs by an upgrowth of the corals of fringing reefs during a slow subsidence of the central island on which they were established; but he did not offer any direct confirmatory evidence of the truth of his fundamental assumption of subsidence. Dana furnished independent confirmatory evidence of the assumption by pointing out that the central islands of barrier reefs are, as far as he had descriptions of them, characterized by embayed coast lines, precisely such as must result if they had subsided; all of their valleys are invaded by the sea and converted into bays. Darwin had noted this fact, but had not perceived its significance, probably because he did not understand that the embayments of a coast line are in nearly all cases formed by the submergence or drowning of preexistent valleys. Dana was the first observer in the world to bring forward this explanation, to-day everywhere accepted, and the first also to apply it to the central islands of barrier reefs. In recent years several Australasian observers have resurrected Dana's idea, and have found in it, as he did, a strong confirmation of Darwin's original theory.

The Formation of Coal Beds: John J. Stevenson, A.M., LL.D.

Cambrian Fossils from British Columbia (illustrated): Charles D. Walcott, Ph.D., Sc.D., LL.D.

Dr. Walcott gave illustrations of a very remark-

able and ancient fossil fauna discovered by him in the mountains of British Columbia, 2,000 feet above Field, on the Canadian Pacific Railway.

The fossils are most beautifully preserved and include such delicate forms as medusæ (jelly fishes), holothurians (sea cucumbers), finely preserved marine shells of various kinds and a large variety of crustaceans. Some of the latter are so perfectly preserved that the branchia, legs and alimentary canal are shown, and even in several forms the liver is so perfect that the ramifications of the tubes through it are reproduced by photography and thus illustrated by lantern slides.

Altogether over 80 genera of invertebrate fossils have been found from a bed not over 5 feet in thickness. They are all of marine origin and lived at a period when there were no vertebrates (fishes, reptiles, mammals) in existence.

The Alleghenian Divide and its Influence upon Fresh-water Faunas: ARNOLD E. ORTMANN, Ph.D., ScD.

Although it is well known that the Allegheny Mountains form a general boundary between the aquatic forms inhabiting their western and eastern slopes, particulars about the relations of the two faunas were missing. In fact, the fundamental facts, the actual faunas of the various streams, chiefly in the mountains, were unknown.

The writer furnishes first these facts for a number of aquatic forms of life, chiefly the fresh-water mussels, the Pleuroceridæ and the crayfishes, covering the region from the New York-Pennsylvania state line to the northern boundary of Tennessee. The main results are, that the groups mentioned have not been transported over land to any extent, and consequently are apt to furnish evidence as to the former drainage conditions. The Allegheny Mountains have acted most of the time as an effective barrier to the dispersal of fresh-water life, surely so since the end of the Cretaceous. The Atlantic side received its fauna from the Interior Basin, but not across the mountains, but around their northern and southern ends. A few instances are known, where single species have crossed the divide, and these cases are found in two sharply-restricted regions: they are probably due to stream piracy.

Neutralization and Elimination of Toxic Substances: OSWALD SCHREINER, Ph.D.

Progressive Evolution among Hybrids of Œnothera (illustrated): BRADLEY M. DAVIS, A.M., Ph.D. Introduced by Professor John M. Macfarlane.

Certain cultures of hybrids between *Œnothera biennis* and *Œnothera grandiflora* have presented in the second generation a high degree of progressive advance in flower size and in the size of the leaves and the extent of their crinkling. A hypothesis for such progressive evolution is offered by the Mendelian principle of recombination of factors for large size on the assumption of multiple factors for the dimensions of organs, but this hypothesis also demands the presence in the same culture of groups of plants containing the factors for small size. When in an F_2 generation there is a considerable group of plants with flowers larger than those of the larger parent there should also be expected corresponding groups with flowers as small or smaller than those of the smaller parent. This follows on the Mendelian law of the conservation of factors by which the factors contained in an F_1 hybrid must all come out in an F_2 generation, provided that this generation is sufficiently numerous and that the formation and mating of gametes present no exceptional features. In F_2 generations of about 1,000 and 1,500 plants, respectively, there were no groups of plants with flowers as small as or smaller than those of *biennis*, the small-flowered parent. There were thus no groups to balance the large proportion of plants with flowers larger than those of the *grandiflora* parent. The cultures as a whole presented a marked advance in flower size.

A similar situation was presented by the character of the foliage in certain F_2 generations. The leaves throughout the mass of these cultures were much larger than those of the parents and generally much more crinkled. There was thus a marked progressive advance in leaf size with the absence of small-leaved groups of plants, and it is difficult to explain the results on strict Mendelian principles of segregation according to which groups in an F_2 generation containing the factors for large leaf-size should be accompanied by corresponding groups containing the factors for small leaf-size.

There was in these F_2 generations abundant evidence of segregation as shown in a range of variation far above that presented by F_1 generations, but this range was between groups of plants with flower and leaf size much greater than those of the two parents. Thus the petals in the larger-flowered groups were 1 cm. longer than those of the *grandiflora* parent with petals 3.3 cm. long, and the flowers of the smaller groups were two or more times larger than those of the *biennis* parent with petals 1.3 cm. long.

Certain of the F_2 generations presented classes

of dwarfs in proportions as high as 1:9 and 1:5.7. These classes were sharply separated from the mass of the cultures and there were no intermediates between the two groups. The high proportions suggest the 1:5 ratio which might be expected if two factors for size were present, each allelomorphic to its absence. Such a simple explanation, however, calls for the appearance of corresponding classes of giants to balance the dwarfs and for several other classes of plants of different sizes composing the mass of the cultures; such classes were not found. The dwarfs then present a puzzling phenomenon not readily understood on current Mendelian views of the segregation of factors governing size.

Admitting the complexity of the situation when such an extreme cross is made as that between *Œnothera biennis* and *Œnothera grandiflora*, there still appears to the writer sufficient reason in the data at hand to present the problems as material for reflection on the Mendelian theory of the stability of factors and the principles of their distribution unchanged in the organization of gametes. The question naturally arises whether the phenomenon of the progressive advance exhibited in the F_2 generation of these hybrids as well as the formation of groups of dwarfs may not involve, as a result of the cross, the direct modification of factors for size.

Climatic Areas of the United States as Related to Plant Growth (illustrated): Burton E. Livingston, Ph.D. Introduced by Professor John W. Harshberger.

This paper deals with that phase of plant geography which relates the distribution of the various forms of vegetation to climatic factors, a phase which is as important to scientific agriculture as it is to what is commonly termed pure science.

Following an introductory consideration of the nature of the problem to be dealt with and some remarks on the sort of means by which we may hope to obtain quantitative information upon the relation of plant growth to climatic conditions, attention is given to the subdivision of the United States into climatic areas more or less susceptible of quantitative definition. Climatic conditions, as far as they influence plants, must be considered mainly as two comparatively distinct groups of environmental factors. The first of these groups constitutes the moisture conditions, tending to furnish the plant with water or to withdraw moisture from its tissues. The second group, the temperature conditions, tend to increase or decrease the temperature of the plant body. As a primary duration factor for the attempted integration or averaging of these climatic conditions, the length of the frostless season is introduced; for practically all animals and perhaps for most other plant forms in the United States, the conditions which are effective during the frostless season have far more influence on plant distribution than have those which are effective during the remainder of the year. Other time periods require attention, however.

From a somewhat thorough study of the climatic data which are at hand it appears that any two systems of isoclimatic lines, one system representing the geographical distribution of temperature conditions and the other representing that of moisture conditions, have a strong tendency to cross each other, thus dividing the country into many climatic areas, each one capable of quantitative description. The remainder of the paper concerns itself with a discussion of selected examples of these areas and of the natural vegetation which characterizes them. This line of study is in its reconnaissance stage and the results are quite tentative in their character.

The Day of the Last Judgment: Paul Haupt, Ph.D., LL.D.

The conception of the day of the last judgment is based on the idea of the day of the Lord in the Old Testament prophecies. Originally the judgment-day, resurrection and immortality referred to the Chosen People. The dry bones in Ezekiel xxxvii represent the Jewish nation in the Babylonian captivity. The so-called eschatological passages as well as the alleged Messianic prophecies have, as a rule, a definite historical background, but when the bills drawn on the future were not honored they were extended to doomsday.

The final chapter of the book of Joel does not contain an eschatological prophecy referring to the end of the world, but the confident prediction of an enthusiastic patriot expressing the hopes of the Maccabees for the near future. Nor does the last chapter of the book of Zachariah refer to the last judgment; originally it predicted merely a decisive victory of the Maccabees over their enemies about 140 B.C. and subsequent engineering improvements in and near Jerusalem.

The ideas of doomsday, resurrection and immortality are secondary, but Ernest Renan is right in saying that there is no lever capable of raising an entire people if once they have lost their faith in the immortality of the soul, and Dr. A. E. Garvey remarks: "He who lives for the ideals of truth,

beauty, goodness, lives not for time but for eternity.''

On the Character and Adventures of Mūladora: MAURICE BLOOMFIELD, Ph.D., LL.D.

On Friday evening at the Hall of the Historical Society of Pennsylvania George Grant MacCurdy, A.M., Ph.D., assistant professor of archeology, Yale University, gave an illustrated lecture on ''The Antiquity of Man in the Light of Recent Discoveries.''

On Saturday morning at 9:30 o'clock an executive session was held in the hall of the society at which candidates for membership were balloted for. As a result of the election, the following new members were announced: ***Residents of the United States***—George Francis Atkinson, Ph.D., Ithaca, N. Y.; Charles Edwin Bennett, A.B., Litt.D., Ithaca, N. Y.; John Henry Comstock, B.S., Ithaca, N. Y.; Reginald Aldworth Daly, Boston, Mass.; Luther Pfahler Eisenhart, Princeton, N. J.; George W. Goethals, Culebra, Canal Zone; William C. Gorgas, M.D., Sc.D., LL.D., Ancon, Canal Zone; Ross G. Harrison, A.B., Ph.D., M.D., New Haven, Conn.; George Augustus Hulett, Princeton, N. J.; Clarence E. McClung, A.M., Ph.D., Swarthmore, Pa.; John Dyneley Prince, Ph.D., Sterlington, N. Y.; Samuel Rea, Sc.D., Bryn Mawr, Pa.; Henry Norris Russell, Ph.D., Princeton, N. J.; Charles Schuchert, New Haven, Conn.; Witmer Stone, A.M., Philadelphia. ***Foreign Residents***—Sir Arthur John Evans, D.Litt., LL.D., F.R.S., Oxford, England; Sir Joseph Larmor, D.Sc., LL.D., F.R.S., Cambridge, England; Arthur Schuster, Sc.D., Ph.D., F.R.S., Manchester, England.

SATURDAY, APRIL 19—MORNING SESSION

Edward C. Pickering, D.Sc., LL.D., F.R.S., vice-president, in the chair

The Potassium, Phosphorus, Nitrogen Cycles: CHARLES E. MUNROE, Ph.D., LL.D., F.C.S.

An Ammonia System of Acids, Bases and Salts: EDWARD C. FRANKLIN, M.S., Ph.D.

Some Unsolved Problems in Radioactivity (illustrated): WILLIAM DUANE, Ph.D. Introduced by Professor Arthur W. Goodspeed.

More than thirty different substances are known to be radioactive in much the same way that radium is radioactive. Most of these substances disappear more rapidly than radium does, only five of them having an average life greater than that of radium, which is about 2,000 years. The average lives of the others vary from a fraction of a second to 24 years.

The law according to which these substances disappear is the same for all of them. It may be stated thus: The rate at which any substance disappears is proportional to the quantity of that substance present, and absolutely independent of all conditions of temperature, pressure and state of chemical combination, etc. This is a very simple law, and the mathematical equations that can be deduced from it probably represent the facts as accurately as any known equations represent facts in other branches of science.

Looked at from another point of view, this law is not very easy to understand. Let us take a particular example. Suppose we have a quantity of that substance called radium emanation. The law applied to this quantity of radium emanation means: that certain atoms of emanation will explode and transform themselves into radium *A*, during the next few seconds, whereas other atoms of this same emanation will remain emanation atoms for a long time, and will not transform themselves for months to come. The question is this: How can atoms which are physically and chemically similar to each other, yet be so different that some of them will disappear immediately and others not for a long time. The explanation of this probably lies in the internal structure of the atom and not in external causes, for external conditions have no known effect upon the phenomenon.

The second unsolved problem to which I wish to call your attention is connected with the rays given off by the substances during their transformations. Some substances produce what are called α-rays and some β-rays, and other substances produce both α- and β-rays. If a particular substance produces α-rays, one and only one α-particle is ejected during the transformation of each atom of that substance, and the same is true of the β-rays. The α-particles from the same substance all have the same velocity. For instance, the α-rays from radium *C* all have a velocity of 2.09×10^9. The β-rays, however, from the same substance do not all have the same velocity. Each β-particle has one of a certain number (8 or 10) of well-defined velocities. For example, each β-particle projected from an atom of radium *C* must choose one of a certain set of velocities lying between 1.85×10^{10} and 2.99×10^{10} cm./sec.

It is difficult to understand why the explosion of an atom, say of radium *C*, which, so far as known, is just like the explosion of every other atom of radium *C*, and produces an α-ray of a

certain definite velocity, should produce a β-ray, having now one velocity and now another. Several attempts to explain this phenomenon have been made, but without complete success. Doubtless the true explanation must be sought for in the internal structure of atoms, as in the first problem mentioned above.

The third problem I will mention has to do with the γ-rays. It is known that the γ-rays are intimately connected with the β-rays, each type of ray being capable of producing the other, but the exact relationship between them is not very well understood. The particular question, however, that I wish to bring up is this: is the γ-ray a wave form spreading out as sound waves do from their source, or is it of corpuscular nature resembling the sparks projected from an exploding rocket? The fact that the velocity of the β-ray, which the γ-ray is capable of producing, does not depend upon the distance from the source of the γ-ray to the point at which the β-ray is produced seems to indicate that the latter hypothesis is correct.

The explanations of these phenomena are intimately connected with the theories of interaction of matter and electricity, and it is interesting to note that the theory, which in modern times has been of most use, the theory according to which both matter and electricity are of atomic nature, was first promulgated about 150 years ago in our own city of Philadelphia by no other than Benjamin Franklin himself, the founder of this society.

Perhaps the most important radioactive problem of practical value upon which scientists are working to-day is the effect produced by the various radiations on human tumors. Photographs were shown illustrating the results obtained in France and Germany by subjecting small superficial cancers to the action of the rays. It must be remembered that the problem of curing deep-seated malignant tumors is by no means solved.

Some Diffraction Phenomena; Superposed Fringes: Charles F. Brush, Ph.D., LL.D.

Diffraction fringes, as usually seen, are not affected by thickness or contour of a smooth, straight diffracting edge, as pointed out by Fresnel. The author finds, however, that when the fringes outside the shadow are observed within one or two millimeters from the diffracting edge, by means of a microscope, their brightness and sharpness are very greatly affected by the character of the edge. For instance, a cylindrical edge of several millimeters radius gives vastly brighter fringes than a sharp razor edge. He finds this is due to superposition of many diffraction fringe patterns which are nearly in register. They are believed to be formed by many contiguous elements of the cylindrical surface, each acting as a diffracting edge and producing its own fringes. The author further shows that the so-called "single mirror interference fringes" of Lloyd may be produced under conditions which preclude reflection, and which at the same time make it obvious that they are formed by superposition of diffraction fringes.

Matter in its Electrically Explosive State: Francis E. Nipher, A.M., LL.D.

New Investigations on Resonance Spectra: R. W. Wood, Ph.D.

Application of Recent Studies on the Origin of the Earth's Magnetic Field to the Possible Magnetic Fields of Rotating Bodies in General (illustrated): Louis A. Bauer, Ph.D.

The Determination of Visual Stellar Magnitudes by Photography: Edward C. Pickering, D.Sc., LL.D., F.R.S.

Ordinary photographic plates are most sensitive to blue light, while the yellow rays are those that affect the eye most strongly. Accordingly, blue stars appear brighter and red stars fainter in a photograph than to the eye. Isochromatic plates are, however, manufactured which are very sensitive to yellow light. If a yellow screen is interposed the blue light is cut off and red stars appear even brighter, relatively, than they do to the eye. By using a thin yellow screen which cuts off only a portion of the blue rays it is possible to obtain plates having the same color index as the eye. To fulfil this condition several blue and several red stars have been selected near the North Pole. Photographs are then taken with different screens until one is found which gives images of the same relative brightness as the naked eye. With the 16-inch Metcalf Telescope at Harvard, stars as faint as the twelfth magnitude may be photographed in this way with an exposure of ten minutes. With an exposure of two hours, stars can be photographed about as faint as they can be seen with a telescope of the same size. On a perfectly clear night a photograph is taken of the North Pole with exactly 10 minutes' exposure, then similar exposures on four different regions, then a second time on the North Pole, on five other regions, and a third time on the North Pole. The twelve plates are developed together and various precautions taken to secure uniform results. The magnitudes of numerous stars near the North Pole have been measured with great care and the mag-

nitudes of stars on the other plates can thus be determined on the same scale.

Some Problems in Connection with the Milky Way as shown by Photographs with a Portrait Lens: EDWARD E. BARNARD, Sc.D., LL.D.

The Spectroscopic Detection of the Rotation Period of Uranus: PERCIVAL LOWELL, LL.D., and V. M. SLIPHER, Ph.D.

By means of the spectroscope, it is possible to measure the speed of approach or recession of a luminous body; for the lines of the spectrum are shifted toward the violet or red in proportion as the body moves toward or from the observer. Hence, if the image of a rotating planet be so thrown upon the slit of the spectroscope that one end of the slit is illuminated by light from the approaching side of the planet and the other end by light from the receding side, the lines will be tilted through an angle which measures the speed of rotation.

In this way, from spectrograms obtained at the Lowell Observatory in 1911, the authors determined the rotation of the planet Uranus about its axis to take place in ten hours and fifty minutes, in a direction opposite to that of the rotation of the planets nearer the sun. Thus, for the first time, an authentic determination of the rotation of this planet has been made by a direct method.

On the Spectrum of the Nebula in the Pleiades: V. M. SLIPHER, Ph.D.

Two photographs of the spectrum of the faint nebula near Merope, a bright star in the Pleiades, were obtained in December, 1912, with a slit spectrograph attached to the Lowell 24-inch refractor. The two plates were exposed five and twenty-one hours, respectively. They agree in showing a continuous spectrum crossed by the dark lines of hydrogen and helium, the spectrum of the nebula being a true copy of that of the brighter stars of the Pleiades. The light of the nebula is thus shown to be of stellar origin. As it seems improbable that a mass of stars, all of the same spectral type as the Pleiades, should so group themselves behind the Pleiades as to give the appearance of a nebula, the author believes it more probable that the nebula consists of diffused material surrounding the stars and shining by reflected star light.

This is the first successful observation ever published upon the spectrum of this faint nebula.

Eclipsing Variable Stars: HENRY NORRIS RUSSELL, Ph.D. Introduced by Professor William F. Magie.

Progress of New Lunar Tables: ERNEST W. BROWN, M.A., Sc.D., F.R.S.

SATURDAY, APRIL 19—AFTERNOON SESSION

Edward C. Pickering, D.Sc., LL.D., F.R.S., vice-president, in the chair

Presentation of a portrait of William W. Keen, M.D., LL.D., president of the society, by Joseph G. Rosengarten, A.M., LL.D., on behalf of the subscribers.

Vice-president Pickering accepted Dr. Keen's portrait on behalf of the society.

The rest of the session was occupied by a symposium on Wireless Telegraphy and Telephony, during which the following papers were read:

Radiated and Received Energy: LEWIS W. AUSTIN, Ph.D. Introduced by Professor William F. Magie.

Mathematical theory indicates that the energy radiated from a radiotelegraphic antenna proportional to the current in the sending antenna, to the height of the sending antenna, to the height of the receiving antenna, inversely proportional to the wave-length and inversely proportional to the distance between the two antennas. Since the loudness of signal is proportional to the square of the current in the receiving antenna, the signal falls off as the square of the distance between the two.

This law has been verified by the experiments made by the United States Navy Department between the new high-power station at Arlington and several other stations situated in and near Washington.

Observations at distances over 100 miles show that in addition to the diminution in intensity of signal with the distance, there is an absorption either in the atmosphere or ground such that at a distance of 1,000 miles over salt water with a wave-length of 1,000 meters the received current is only approximately 1/25; that is, the received signals are reduced to about 1/600 of what they would have been had there been no absorption.

The absorption decreases as the wave-length is increased, so that for communication over great distances, long waves, 4,000 to 7,000 meters in length, are used, while for short distances of a few hundred miles short waves are better since they are radiated more energetically. These facts apply to daylight communication only, which is in general regular, night ranges, though greater than day, being freakish and uncertain. The absorption over land is much greater than over water, especially for the shorter wave-lengths.

In recent tests between the Arlington station and the scout cruiser *Salem* on its voyage to Gibraltar and return, messages were received from Arlington in the day time on the *Salem* up to a distance of 2,100 nautical miles, and at night as far as Gibraltar.

A comparison was also made of the action of two types of sending sets, one being the regular spark sending set and the other set in which the waves are produced from an electric arc. It has been claimed that the continuous waves emitted by the arc are less absorbed than the broken-up trains of waves produced by the spark. Up to 1,000 miles no difference in the absorption was observed, but at 2,000 miles the observations indicated that the received arc energy was relatively four times greater than that of the spark.

Resonance in Radiotelegraphic Receiving Stations: George W. Pierce, A.M., Ph.D. Introduced by Professor Arthur W. Goodspeed.

A New Form of Resonance Circuits: Michael I. Pupin, Ph.D., Sc.D.

The International Radiotelegraphic Conference of London and its Work: Arthur Gordon Webster, Ph.D., LL.D.

The great development of wireless telegraphy and the embarrassment arising from interference in communication and the refusal of different companies to transmit messages at sea led to the necessity of international control, and brought about the Conference of Berlin in 1906. It was then decided that these conferences should be periodic, and the second one was held in London in June and July, 1912. The United States sent a delegation of twelve members, representing various departments, including the army, navy and commerce and labor. The working of the conference was described, and the strong personnel of the representatives of the more than forty countries represented. All governments except that of the United States, owning the telegraphs, are able to exercise absolute control, and were represented by high officials of their post-office and telegraph administrations, as well as by military officers.

The work of the conference was concerned mainly with the questions of prevention of interference between different stations, of increasing the safety of vessels and of the prevention of abuses in improper competition, the latter being a matter in which this country was not interested. The question of interference occupied the major part of the time of the conference. Two standard wave-lengths were adopted, which were made obligatory, so that there could be no excuse for not hearing messages. The amount of power to be used was limited, so that it should not be in the power of one station to drown out others. On account of difficulties in crowded waters like the English channel, surrounded by several nations, strict rules of precedence were established and the multiplication of useless calls was restricted. Attempts to overreach one country by powerful stations belonging to another caused considerable feeling and were regulated.

In the interest of security, all stations are to be licensed by their governments. Operators must also be licensed, and shall be of two classes, according to proficiency. Operators of the second class are to be permitted only on small ships, and as substitutes on those having one operator of the first class. The wireless stations are put under the authority of the officer in command of the ship. On passenger ships there must be a special emergency plant capable of operation independently of the ship's power, and strong enough to reach eighty miles. Such stations must listen for distress calls for ten minutes of each hour. High-power shore stations must periodically cease transmitting, in order not to interfere with distress calls. Distress calls are given absolute preference. The transmission of meteorological news is facilitated by giving it priority, when sent to certain designated designations.

The author expressed the opinion that in spite of all that had been done, before the next conference, to be held in Washington in 1917, wireless traffic would have so increased that much more stringent regulations, as well as improved methods of tuning, would be necessary.

A general discussion followed, led by Professor Elihu Thomson.

At the annual dinner on Saturday evening, at the Bellevue-Stratford, over one hundred members and guests were present, the toasts being responded to as follows:

"The Memory of Franklin," by His Excellency the French Ambassador.

"Our Guests," by Professor Arthur Schuster.

"Our Institutions of Learning," by Professor A. G. Webster.

"The American Philosophical Society," by Mr. Hampton L. Carson.

Arthur Willis Goodspeed

Philadelphia,
April 23, 1913